THE

Canadian Engineer

INDEX

VOLUME XI.

1904

INDEX.

Articles indexed with prefix "ad. p." appear among the advertisement pages.

BIOGRAPHICAL SKETCHES.

CONTRIBUTED ARTICLES.

CORRESPONDENCE.

PORTRAITS.

INDEX.

INDEX.

The Canadian Engineer

Vol. XI.—No. 1. TORONTO AND MONTREAL, JANUARY, 1904. PRICE 10 CENTS $1.00 PER YEAR

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY; MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada, Great Britain and the United States, $1.00 per year, foreign, 6s. Advertising rates on application.

OFFICES—18 Court St. Toronto; and Fraser Building, Montreal.
Toronto Telephone, Main 4310. Montreal Telephone, Main 2589.
BIGGAR-SAMUEL, LIMITED, Publishers,

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 15th of the preceding month or if proof is desired, 4 days earlier.

CONTENTS OF THIS NUMBER

THE METRIC SYSTEM.

In last issue we printed a letter by F. A. Halsey, of New York, on the subject of the metric system. As believers in the metric system, we are always glad to offer fair play and ample space to those who, like Mr. Halsey, are wedded indissolubly to the time-honored but medley-burdened mediæval system of English weights and measures. Such articles do much good by drawing attention to the subject, and the more fully the subject is ventilated the more rapid becomes the advance of the superior, simpler and more scientific metric system. Beginning with a single nation, France, the metric system has spread from one country to another until, with the exception of the English-speaking countries, only uncivilized nations have failed to adopt it.

The burden of Mr. Halsey's letter appears to be that the English system is better than the metric system, that the metric system is not really used in European countries, but only pretended, and that a metric country can only construct machines to metric sizes.

Now, as regards the advantages of the metric system, they are sufficiently evident from the fact that all weights and measures are reduced to one unit—the metre, for all volumes are in terms of the cubic metre, and all weights are in terms of a cubic metre of water, or a sub-decimal thereof. Consequently the metre, litre and gramme form an ideally simple trio of rationally connected units to which all sizes are referred, be it the micron or millionth of a metre for microscopic work, the millimetre or centimetre for tools, or the kilometre for road lengths. With three units as the stock-in-trade and a few names for decimal multiples and submultiples the system is harmonious, definite and complete. Against this we have a burdensome, indefinite and incoherent mass of English tables that few persons remember. We have over sixty different units of length, area, volume and weight, these units being connected by farcical and fanciful weird ratios, such as 5,280 feet in a mile and 43,560 square feet in an acre. In the centuries that are to come we cannot expect our descendants to believe that we at this age were even semi-civilized when they look back upon our present system of weights and measures.

The only valid objection to the metric system is that, being a decimal system, it does not lend itself to repeated division by halving. But that is an objection to our arithmetic, and not to the metric system. A duodecimal arithmetic would have distinct advantages over a decimal arithmetic; but it is quite hopeless and impracticable to change the world's arithmetic; while a very large part of the world has already changed its weights and measures for the metric system, and it is clearly only a matter of time when all civilized nations will employ that system exclusively. No one complains that a dollar can only be divided by two twice before the even halving ceases (at twenty-five cents); whereas a pound sterling can be divided into successive halves four times before coming to a similar barrier at fifteen pence. The decimal coinage is, we all know, far superior to the old English system in spite of the limited capability of splitting in halves.

Moreover, in our English medley we constantly tend to the use of decimal subdivisions. Workmen in machine shops employ inches and mils, and commonly work to the nearest mil or decimal subdivision (1-1,000) of an inch, and do not go on splitting hairs and dividing by two. It is more rare to employ thirty-seconds than hundredths or thousandths. Similarly surveyors use feet and hundredths, not feet and inches. Hydraulic men use thousands or millions of cubic feet, or gallons, and not barrels or tons. Everywhere men struggle to throw off the duo-decimal yoke. Our money has already thrown off the fetters. Our weights and measures will do so sooner or later.

But the proof of the value of the metric system lies in the practical experience with it. All Europe uses it except England. No country regrets having made the change. The same outcry was made in each country by the conservatives before the change was made. In

Germany, for instance, the people who were too old to learn anything new, and the conservatives who saw no good in anything that did not originate in Germany, clamored against the introduction of the metric system. The literature of that day is full of pathetic pleas. We cannot change. The change is bad. We will not change. The change cannot be made. Nevertheless the change was made with very little trouble, and now no reasonable Germans ever use an old German unit except in sport.

Mr. Halsey would have us believe that Europe is in a state of seething insurrection against a compulsory adoption of the metric system. The writer has lived for a number of years in various countries of Europe, and has never seen or heard of any units used or suggested, outside of England, except metric units.

The American Chamber of Commerce in Paris recently asked the Society of Civil Engineers of France whether the old French units such as arpent, once, aune and boisseau, were still used. The society replied that they are not so used, and cited their use in phrases which are mere meaningless old sayings as vestiges of past use.

In America to-day the "shilling" is still occasionally spoken of. In Philadelphia there are still a few rents that are paid in Spanish dollars. Possibly the cloth-yard, the ell, the league and the cubit may be yet in existence. These were all in national use at one time. Does anyone hesitate on this account to say that America has a decimal coinage and no longer uses the cubit or the league.

The argument that if we were to adopt the metric system at a given date thereafter our inch machines would be useless is another fallacy that history has overthrown. It was used in all the European countries before they changed to the metric system. The German manufacturers declared that as soon as the metric system was adopted their tools would be rendered useless, because they were constructed to give German inches. There was no such trouble. The same tools were used after the system for years, making sizes that were not even metric sizes, employing odd decimals. But every machine uses decimal sizes when working to its ultimate degree of accuracy. There is no such thing, in practice, as an inch pipe. It is always a small decimal over or below an inch. So that whether the decimals are of an inch, or of a centimetre, is of little consequence. In the course of years it would, however, probably be convenient to build machines that turned out approximate even metric sizes.

The attitude of Canadian business men towards the metric system is shown in the resolutions adopted by the fifth Congress of the British Empire, held in August last at Montreal. At this congress there were business men, not scientists, representatives from Chambers of Commerce of the various British colonies, and a very strong resolution was passed by the Congress in favor of a general adoption of the metric system in the Empire by a large majority. The Canadian Manufacturers' Association, composed of manufacturers representing every industry in Canada, has declared more than once in favor of it, as has the Retail Merchants' Association.

The progressive colony of New Zealand has within the last few months passed a Weights and Measures Act, which contains a clause rendering it lawful for the Governor at any time by proclamation to declare that from and after the date named in the proclamation, being not sooner than the first day of January, 1906, "the metric system shall be the only system of weights and measures recognized for use in New Zealand; and thereafter it shall not be lawful to use any weights and measures other than those."

INDEPENDENT TELEPHONY IN CANADA.

The year 1904 promises an active development of telephone competition in Canada. Several of the larger cities of Ontario will have before them at an early date applications for franchises to compete with the Bell Telephone Co. Judging from the widespread dissatisfaction prevailing against the rates and service of the existing monopoly, the advent of competition will be welcomed by the majority of telephone users, and also by very many who are debarred by the prevailing rates from participating in the benefit of telephone facilities. Doubtless, a great effort will be made by the existing companies to persuade city councillors that the telephone is a natural monopoly, and that competition elsewhere has not been satisfactory to the general public. Articles have been published in the Canadian Engineer, from time to time, which furnish conclusive proof of the success of independent telephone competition in the United States and Europe, and if further evidence were needed to demonstrate this fact volumes might be written containing records of successful independent exchanges. It is well, however, that at this stage those responsible for the granting of franchises should proceed cautiously and ascertain what are the conditions which have produced the successful results recorded. A careful study of these conditions will show that to enable the people to have telephone service at permanently low rates, there must be local control and no overcapitalization. In other words, the competing exchanges, if not municipal, or co-operative, should be controlled by local capital in which there is no watered stock or bonded indebtedness. If franchises are granted to syndicates representing outside capital, who are in reality only promoters, whose object is either to bond the plant, or float operating companies, retaining for themselves a large amount of watered stock, upon which subscribers have by their rentals to pay dividends, the result in the end will be failure, and the tightening still further of the grasp of the monopoly. A company has recently obtained a Dominion charter, and with a capital of only $1,000,000 they propose to build exchanges and construct long distance lines throughout Canada in competition with the "Bell" Company. It is obvious that this amount is totally inadequate to carry out the objects for which the charter was obtained, and it is further stated that the company propose to accomplish their purpose by a number of local companies bearing different names, and which we assume will be subsidiary to the existing corporation. This means that the present company will have a large interest in each subsidiary company, may, in fact, control them.

While favoring the advent of independent telephony in Canada, we confess that we should like to know something more regarding this company's future policy, before any operating franchises are given away. We believe that competition should come from the people, as it has done in the United States, with few exceptions, and therefore if local companies are established, it should be possible to accomplish this without the necessity of their being promoted and controlled by any corporation having its management in one Canadian city or the United States. One of the chief reasons for the unpopularity of the "Bell" Company is that its system of centralized management keeps it out of touch with the local needs and sympathies of the subscribers to its exchanges in all parts of Canada, and we do not wish to see this policy duplicated in independent telephony. We have also noticed that the financial success of the independent telephone movement in the United States has, in recent years, resulted in the consolidation of a number of companies, and the present indications are that the most

prosperous exchanges will in the near future fall under the control of a large trust, stocks will be watered, rates increased and the probabilities are that unless this movement is checked, a deal may be made with the "Bell" monopoly, whereby they will again control the telephone business of the United States. To illustrate our meaning we would refer to the Federal Telephone Company, of Cleveland, with a capital of $10,000,000, which was incorporated for the purpose of purchasing the securities and controlling the operating policy of a number of the largest independent telephone companies in Ohio and Michigan. It controls seventeen companies, and the following table will show that they are very much overcapitalized:

Overcapitalized Independent Telephone Companies, Whose Operations are Controlled by the Federal Telephone Company of Cleveland.

Name of Company.	Miles of Toll Lines.	No. of Subs.	Capital.	Bonded Indebtedness.	Average per Subscriber.
Cuyahoga Telephone Co.	90	9,710	$3,000,000	$2,233,000	$539
Columbian Telephone Co.	301	2,355	300,000	200,000	212
Findlay Home Telephone Co.	....	972	150,000	80,000	235
Citizens' Telephone and Mess. Co.	....	736	50,000	44,000	127
Lancaster Telephone Co.	95	732	100,000	50,000	249
Lima Telephone and Telegraph Co.	....	870	150,000	70,000	253
Mansfield Telephone Co.	88	1,575	300,000	200,000	317
Massilon Telephone Co.	48	902	75,000	75,000	166
United States Telephone Co.	8,647	200	2,000,000	1,865,000	447*
Youngstown Telephone Co.	....	1,747	200,000	200,000	229
Janesville Telephone Co.	55	1,251	250,000	150,000	320
Columbus Telephone Co.	....	6,277	705,000	650,000	216
Akron Telephone Co.	32	3,011	300,000	300,000	199

*This a long distance company and the figures in the last column give the average per mile of toll line.

In contrast with the Cuyahoga Telephone Co. (which is the largest of the Federal companies), with ninety miles of toll lines, and 9,710 subscribers, having a capitalization and bonded indebtedness averaging $539 per subscriber, the Citizens' Telephone Company, of Grand Rapids, Mich., with 2,000 miles of toll lines and 10,448 subscribers, has no bonded indebtedness and a capitalization averaging $96 per subscriber. The experience of competition in the United States points to the necessity of adopting such legislation in Canada as will prevent the amalgamation of groups of local companies with the inevitable watering of stock, and raising of rates which always follows in the train of such consolidations.

We might also point out that the People's Telephone Company, in Detroit, Mich., was an undoubted success until it was persuaded, on the plea of strengthening independent telephony, to amalgamate with the Erie Telephone Co., a corporation professing independent principles, but which afterwards sold out to the "American Bell" from which time Detroit has always been held up as an example of the impracticability of telephone competition. Had the "People's" retained control of their system, Detroit, to-day, would have a service surpassing any independent system in the United States. This is a striking illustration of the undesirability of permitting franchises to get into the hands of companies, whose whole primary object is to run the business for all that it may be worth, the interests of the people being a secondary consideration.

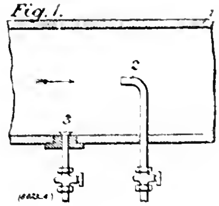
The advent of improved methods involving cheaper construction and maintenance, renders it possible to supply the people with telephones at almost one-half the existing rates, and at the same time to earn good dividends on the capital outlay, but the one means of obtaining and maintaining these low rates is by granting franchises only to local companies, independent of outside control, who shall satisfy the people that their capital is free from "water" in any form, and that the people will get what they have a right to expect, viz., service at rates which include a fair profit on the actual cost of building and operating the system. Failing this, the only available remedy for the existing high rates is municipal ownership.

TESTING ELECTRIC GENERATORS BY AIR CALORIMETRY.

An ingenious and entirely novel way of testing alternating-current dynamos was recently brought before the Institution of Electrical Engineers, London, England, by Richard Threlfall, M.A., F.R.S., of Birmingham. There is considerable uncertainty about large alternating-generator tests, and frequently, as in the case which confronted Mr. Threlfall two years ago, neither brake-power tests can be applied, because the fields of alternators are built upon the flywheels, nor, owing to structural difficulties, can one machine be run as generator and the other as motor. It occurred to him, hence, to enclose the alternators in a non-conducting casing, and to pump air through the system at a measured rate. If M kilogrammes of air of specific heat o be passed through the system per second, and the temperatures of the air on entering and leaving be t and zero degrees Centigrade, and if no heat be lost or gained by the alternator, then M o (zero—t) = H will represent the rate at which power is being wasted in kilogramme-calories. If, further, P represent the rate of external working of the engine, P^1 the power delivered by the generator in kilowatts, then the efficiency of the generator is $E = P^1/P = P^1 (P^1 + H)$. Assuming that the dynamo does not radiate like a wireless telegraph transmitter, E and H can be determined, provided we can measure the bulk of air; and this method should share with the Hopkinson method the advantage we determine in H the actual loss in the generator from all sources, and that—supposing a loss of 10 per cent., or an efficiency of 90 per cent.—any error made in the determination of H would enter by one-ninth of its amount only into the efficiency E.

The measurement of the current of air is the hard problem which Mr. Threlfall had to solve, and he finds that H can be determined in practical trials within 2 or 3 per cent. It is done with the aid of Pitot tubes, simple tubes bent over at the end, which have long been used to explore the velocity of flowing liquids. When air streams against the open end of the Pitot tube (2 in Fig. 1), which is closed

Fig. 1.

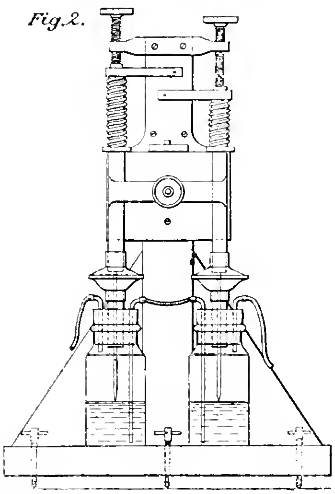


otherwise, a certain pressure, known as velocity pressure, is set up in the Pitot tube, because some of the momentum of the impining air is destroyed by the quiescent air in the tube. It has been shown by Lord Rayleigh and confirmed

experimentally in these researches by Mr. Threlfall, that this lost momentum amounts to almost exactly half of the total, and that the velocity pressure is nearly equal to $\frac{p V^2}{2}$ dynes per square centimetre, where p is the density of the air in grammes per cubic centimetre, and V its velocity in centimetres per second. A side gauge has to be provided to mark the static pressure of the external air. This may be a flanged tube (3 in Fig. 1), according to Heenan and Gilbert; or a hole may simply be drilled into the wall and a pipe screwed into it; but then care must be taken to avoid the very variable suction effect.

From the Pitot tube and the side gauge rubber tubes extend to the two bottles communicating with one another (Fig 2) by a siphon, in which readings of the pressure dif-

Fig. 2.



ferences are taken with the aid of needle points. The needles are set just to touch the colored water in the bottle; the level difference is, in the instrument illustrated, which Mr. Threlfall has himself made and used daily for two years, measured by callipering jaws to within 0.01 millimetre; in a new form, made by the Scientific Instrument Company ,of Cambridge, a micrometer screw effects the reading within one second. A multiplying pressure gauge, in which the motion of a float operates a finger moving round a dial, which indicates square roots of the pressure differences (as the velocity $V = \sqrt{2p/p}$), serves as an auxiliary instrument. From Rateau's experiments we know that we want the means of the square roots of the pressure differences. If the velocity were the same at the various points of a vertical section through which a fluid is streaming, Mr. Threlfall's task would have been easy. For water we may, according to Darcy, take as average velocity that at the circumference of a circle of radius r, when R is the radius of the pipe, defined by the equation $r = 4^{\frac{2}{7}} R = 0.689$ R, or approximately 2-3 R. But for an air current produced by a ventilator, no such law holds, even if baffles are used. Mr Threlfall found Marey's device of passing the air through muslin—mosquito netting, in fact—useful to secure a uniform though arbitrary velocity distribution. He had, however, to explore a whole section of his air pipe, 21 in. in diameter, thoroughly with the aid of a small size Pitot tube made of tin or millboard, the other large Pitot tube being kept in the centre of the air pipe and joined together with its side gauge to the auxiliary pressure gauge in order to make sure that the fan speed keeps fairly regularly during this exploration. ... this sounds formidably complicated. Mr. Threlfall wa[s, ho]wever, able to convince himself, by experiments, ta[bulated] in his paper, that the pressure distribution over the vertical section of his pipe remained practically constant with considerable changes in the velocity of the air current, which was varied between 325 feet and 3,640 feet per minute. When, however, the positions of the fan and pipe are altered, a new calibration has to be made. The calculation of the results of an experiment, fully given in the communication, is not difficult. For carrying out the actual tests, the 300-kilowatt alternator of 40 periods, which runs for about one-third of its diameter in a pit of concrete, was encased in wood, and the pit, which exposed a good deal of concrete, boarded round, and 3-4-in. of felt fastened over the boards. The whole casing was papered and covered with tinfoil. The fan was run at such a speed that the mean temperature within the casing remained as high as that of the engine-room. This was easily attained, and there was little danger, therefore, of direct heat leakage; connection and radiational losses were proved to be very small. Kew standard mercury thermometers were placed in the inlet and outlet, and at various points. Before the final tests were entered upon, attempts were made to measure the external currents by sending them through iron strips, 3-4-in. wide, 1-25-in. thick, wound in zig-zag in a water tank. This water calorimeter was not wanted afterwards, but experiments were conducted with 130 ft. of this iron strip to ascertain the heat effect produced in the enclosure when a current of known strength was sent through this iron resistance.

Electrical measurements were also made with the aid of a Kelvin kilowatt balance, a Duddell oscillograph, and, further, a new hot-wire voltmeter, designed and constructed by Mr. Threlfall himself, and found reliable and very sensitive during three years of continuous use with currents of 2,000 amperes maximum and 40 periods. The instrument responds to currents of 0.01 volt, and is reliable within 1 per cent. The wire is the finest silver (lace) wire obtainable. A length of about 6 centimetres is fixed between a support and the multiplying device working the micrometer screw. The wire is kept stretched by a spiral of the same wire attached to a hook, resting on the middle of the wire. As the change in length effected by the current heat is measured, the stretching must always be uniform. To ensure this, a second wire is fixed over the first and a little mirror attached to it, which mirror is tilted by the stretched calorimeter wire, whose two arms form an angle of 179 deg. The light of a small glow-lamp is reflected by this mirror, and this image is watched through a window in the front of the double aluminium case covering the instrument.—Engineering.

NEW COMPANIES.

The Toronto Coral and Mycenian Marble Co.; $100,000. J. W. Moyes and others.

The Credit Forks Vitrified Stoneware Sewer Pipe Co., Toronto; $200,000. Robert Carroll and others.

The Damascus Gold Mining Co., Bridgeburg, Ont.; $250,000. J. S. Lovell, of Toronto, and others.

The Redpath Motor Vehicle Co., of Berlin, Ont.; $50,000. A. H. Reid, of Toronto, and others.

The Ontario Pipe Line Co., St. Catharines, Ont.; $40,000. J. M. Walker and others.

The Pacific Coal and Oil Co., Toronto; $17,500,000. J. S. Lovell and others.

Les Transports Canadiens, Limited, Toronto; $1,000,000. E. L. Sawyer and others.

The American Asbestos Co., Montreal; $1,000,000. H. M. Whitney, of Boston, Mass., and others.

The Imperial Construction Co., Toronto; $199,000. C. A. Masten and others.

The Duplesis Independent Shoe Machinery Co., St. Hyacinthe, Que.; $2,000,000. P. A. Lebadie and others.

The Ripley Acetylene Gas Co., Ripley, Ont.; $2,000. S. T. Jackson and others.

The Canada Handle Co., Hull, Que.; $40,000. Chilion Jones, of Brockville, Ont., and others.

The Montreal and South Shore Auto-Car Co., Montreal; $30,000. W. B. Powell and others.

The Erie and Ontario Development Co., Welland, Ont.; $90,000. E. A. C. Pew, of Toronto, and others.

Canadian Contractors, Limited, Montreal; $3,000,000. E. L. Sawyer, of Toronto, and others.

The Ontario Traction Co., Walkerville, Ont.; $40,000. C. M. Walker and others.

The Grimsthorpe Mining Co., Toronto; $150,000. G. G. S. Lindsey and others.

The Valley Seating Co., of Dundas, Ont., $75,000. J. D. Pennington and others.

The Wilcox Manufacturing Co., of Ontario, Limited, London. Ont.; $40,000. C. E. Santo, of London, Ont., and others.

The Continuous Rail Joint Co., Montreal; $49,000. W. W. Near, of Guelph, Ont., and others.

The Steamship Senlac Co., Rothesay, N.B.; $80,000. Robert Thompson, of St. John, N.B., and others.

The King Edward Oil Co., Limited, St. John, N.B.; $40,000. W. T. Clark, of St. John, N.B., and others.

Maritime Engineering Co., Limited, Moncton, N.B.; $30,000. J. P. Weir, of Moncton. N.B., and others.

The Imperial Coal and Coke Co., Montreal; $4,500,000. F. Thompson and others.

The Toronto Iron and Steel Co.; $40,000. R. E. Mills, of Guelph, Ont., and others.

The Roche-Persee Mining Co., Winnipeg, Man.; $100,000. H. Sutherland and others.

The A. R. Williams Machinery Co., of Winnipeg, Man.; $60,000. A. R. Williams, of Toronto, and others.

The Threshers' Supply Co., Winnipeg, Man.; $90,000. J. R. Morris and others.

The Idaho-Alamo Consolidated Mines, Limited, Alamo, B.C.; $650,000.

The Princess Royal Gold Mines, Limited, Rothesay, B.C.; $1,250,000.

The Perry Creek Gold Mining Co., Perry Creek, B.C.; $500,000.

The Great Northern Mines, Limited, Trout Lake, B.C.; $1,500,000.

The Britannia Power Co., Victoria, B.C.; $250,000.

The Pacific Pile Preserving Co., Victoria, B.C.; $20,000.

The Light Traffic Co., Victoria, B.C.; $150,000.

The "Stanley Dollar" (Steamship) Co., Victoria, B.C.; $50,000.

MR. HALSEY ON THE METRIC SYSTEM.

Editor, Canadian Engineer:

Sir,—Does the writer of the letter in your last issue on the metric system wish us to believe that because some people in Europe still speak of the old weights and measures, therefore the metric system is not in use. On such an assumption Mr. Halsey might publish a violent declaration that dollars and cents have not been introduced here because he can assert truly that the Constitution of the Commonwealth of Massachusetts, as published in the latest revision of our laws, contains the following provision:

"In all cases where sums of money are mentioned in this Constitution, the value thereof shall be computed in silver at six shillings and eight pence per ounce," etc.

A few years ago a newsboy on a railroad train who had difficulty in making a few cents change with one of my fellow passengers came to me, asking if I had any "pennies." I am willing that Mr. Halsey should argue from one end of the United States to the other that this proves that the United States has been unable to abandon pounds, shillings and pence, and has not been able to introduce a decimal monetary system. A number of years ago I was informed that the price of a dinner was "two and threepence." Mr. Halsey is welcome to make the most of this. ENGINEER.

Boston, Mass., 15th Dec., 1903.

W. Moore & Sons, Meaford, Ont., are developing a 600 horse-power water power. The dam will be 710 feet long, and the race 1,600 feet. The work will be completed next summer, when power will be sold to other factories desiring to utilize electric energy.

PUMPING BY ELECTRICITY.*

BY F. H. PITCHER, C.E., CHIEF ENGINEER, MONTREAL WATER AND POWER CO.

Our large cities in the East, like Montreal, Toronto, Hamilton, Ottawa, Quebec, etc., are more favorably situated, perhaps, for obtaining cheap electric power than corresponding cities in the New England States and others along the Atlantic seaboard. This is on account of their proximity to large water powers, capable of commercial development. None of these cities is, everything considered, in a better position in this respect than Montreal. Its population, manufacturing and kindred industries offer a ready market for a large amount of power, while its proximity to the developed and undeveloped powers on the Richelieu, St. Lawrence, Ottawa, and Shawinigan rivers makes it possible to supply the demand on a commercial basis.

The following are the principal developed water powers delivering under normal conditions of operation power to Montreal, approximately, as follows:

At Chambly, Que., 21 miles from city .... 20,[illegible] h.p.
At Lachine Rapids, Que., five miles from city .... 1[illegible] h.p.
At Shawinigan Falls, Que., 80 miles from city .... [illegible],000 h.p.

The latter is a 30,000-h.p. development. The remainder of the power is being absorbed now by the industries at Shawinigan Falls, or will, in all probability, shortly be taken up by this city as well as by other towns and cities along the line. All of these powers are capable of expansion, and are even now being extended, so that there is little doubt that twice the present amount of electric power from water powers will be available in Montreal in the near future. The principal undeveloped powers near the city are:

Back River, six miles from city .... 50,000-h.p.
Soulanges Canal, thirty miles from city .. 25,000-h.p.

Another important available water power of 50,000-h.p. has been developed at Massena, N.Y., approximately sixty-five miles away.

It is, therefore, not unnatural that electricity should form an important factor in the motive power of Montreal. As a matter of fact, for factory and machine shops drives, elevators, street railway power, pumping, etc., electricity from adjacent water powers is largely used at present in Montreal, and by proper management there is every reason to believe that its use in the near future will so increase that present local steam plants will be retained mainly as auxiliaries and reserves. Under normal conditions all public street lighting and practically all indoor lighting in this city is at present furnished by water powers.

The water-works system making the greatest use of electric pumps in Canada, if not in America, is that owned and operated by the Montreal Water and Power Company. The source of supply is the St. Lawrence river, above Montreal, the 30-inch intake pipe of the old Ste. Cunegonde waterworks being utilized. The water is taken at a point 1,650 feet (approximately) from the shore and is pumped directly into the mains. The municipalities supplied are the towns of Cote St. Paul, Verdun, St. Henri, Ste. Cunegonde, Westmount, Outremont, St. Louis de Mile End, De Lorimier, Maisonneuve, with St. Denis' ward of the city of Montreal. An altitude of [illegible] feet above the river is reached in one of the municipalities.

From the nature of things three lifts were found necessary, one of 200 feet from the river forming the main supply. This supply is pumped through force mains approximately 6,500 feet long, and then distributed through the gridirons of the towns in front of the mountain lying "below the hill" and at only a slight elevation above the average river level. The population receiving its supply from this lift is approximately one-half of the present total population supplied. In order to supply most of Westmount, and a large part of the territory behind the mountain, a second lift of 270 feet was established. The pumps at the 200-foot level take their water from a catch-basin of relatively small capacity, which receives the surplus water of the low-level system. These again pump directly into a reservoir of 8,000,000 Imperial gallons' capacity (approximately), at an elevation of 470 ft.,

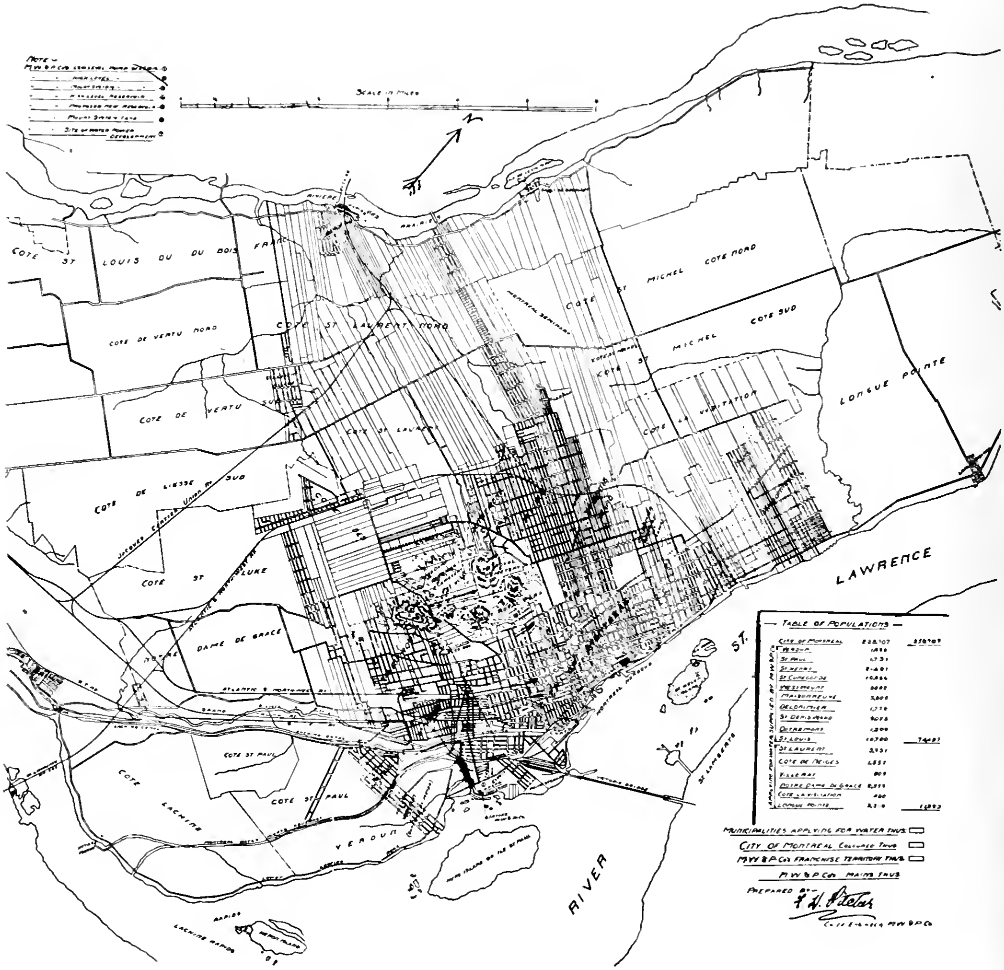
and also into the mains, there being no separate system of rising mains. This lift supplies practically all the other territory both in front of and around the mountain. The pressure for the low territory, like Maisonneuve, etc., is controlled by regulators. This is, of course, not the most economic final plan, but at present the amount of water let down through the regulators is not over 25 per cent. of the whole supply. A plan to establish a low-level reservoir connected with the back territory by a low-level gravity main around the western spur of the mountain, is now under consideration.

Besides the two lifts mentioned, there is a third, established in 1898 for the supply of a few houses on top of the Westmount Mountain. This is a lift of 180 feet (approximately), and as yet of small importance in point of size. were two direct duplex steam pumps; one of 2,000,000 and one of 1,000,000 Imperial gallons daily capacity. The larger pumps were added to each station as the consumption in the front grew and before the back territory was connected to this source.

(To be continued.)

❧ ❧ ❧

The London Daily Mail has conducted experiments with a recording telephone, or electrograph, the invention of E. G. Craven, an English engineer, once an assistant of Edison. It is a combined telephone and phonograph. Messages spoken into the transmitter in London were received by the phonograph at Wickenham, twelve miles distant, without audible sound, on a vibrating diaphram. When the phonograph was disconnected from the telephone and reversed,



City of Montreal—Pumping by Electricity.

To-day over 80,000 people are being supplied in this way. Seven and one-half million gallons are consumed daily, and the pumping at all three stations is done by electric pumps. The low-level station is at the river in St. Gabriel Ward of the city proper, and is called St. Gabriel Station. The intermediate station is on Clarke Ave., Westmount, at an elevation of 200 feet, and is called Clarke Ave. Station. The remaining station is at the reservoir and is called the Mountain System Station.

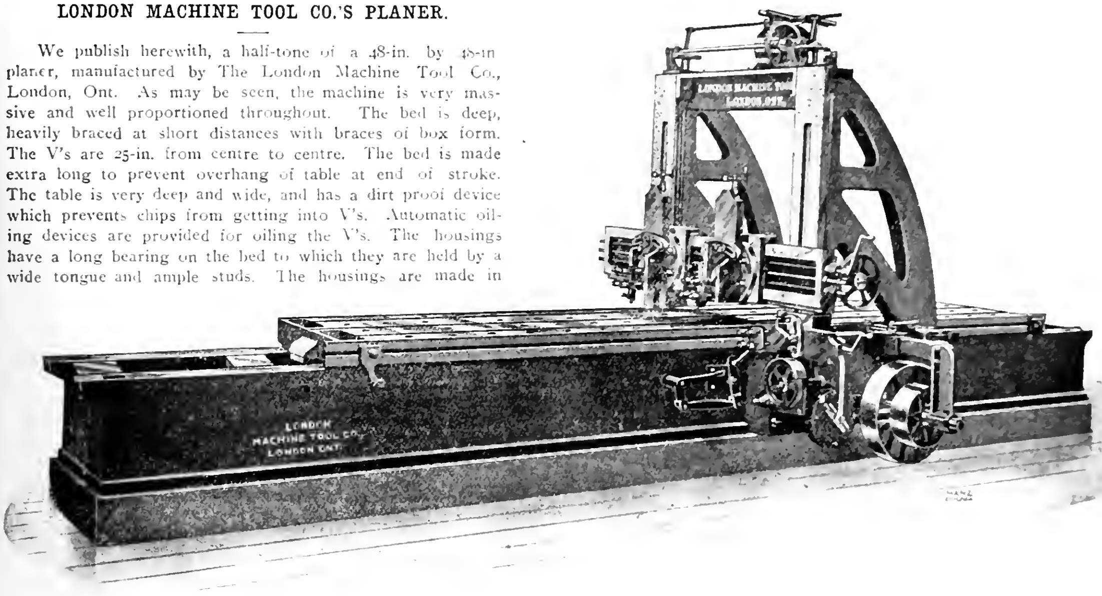
The pumps at the low-level station, in 1898, were two in number—one an old type crank and fly-wheel quadruple Holly of about 750,000 Imperial gallons' capacity, and the other a duplex direct Snow steam pump of about 3,000,000 Imperial gallons' capacity. At Clarke Avenue there the messages were reproduced audibly and distinctly. The inventor claims that his invention will be the greatest convenience to business since the telephone, as it makes a permanent record of conversation.

❧ ❧ ❧

The Toronto Railway state that their new storage battery plant will be in use in three months. It will supply power to run the additional service, morning and evening, necessary to convey the people to and from business. The power will be stored during the day when traffic is light. The plant will have a capacity of 3,500 to 4,000 horse-power. At present 8,000 horse-power per hour is required to operate the service.

LONDON MACHINE TOOL CO.'S PLANER.

We publish herewith, a half-tone of a 48-in. by 48-in planer, manufactured by The London Machine Tool Co., London, Ont. As may be seen, the machine is very massive and well proportioned throughout. The bed is deep, heavily braced at short distances with braces of box form. The V's are 25-in. from centre to centre. The bed is made extra long to prevent overhang of table at end of stroke. The table is very deep and wide, and has a dirt proof device which prevents chips from getting into V's. Automatic oiling devices are provided for oiling the V's. The housings have a long bearing on the bed to which they are held by a wide tongue and ample studs. The housings are made in heavy box form and are of a style best calculated to resist the strains of cutting. The bar is raised and lowered by power, the lever for which is easily reached by operator. The heads have power and hand feeds in every direction, the swivels are graduated to degrees. The shoes have long bearings on bar and are accurately scraped thereto. The driving mechanism is simple but powerful. Loose pulleys are all bronze bushed. The driving pulleys can be arranged for either parallel or right angled drive. Feeds are driven by either friction or positive gear, as desired. This machine can be arranged for motor drive and also can be arranged for the use of high speed cutting steels. The weight of this planer with 14-foot bed is 32,000 lbs.



* * *

THE WATER OF THE GLOBE.

Sir,—Moses, in his account of the genesis of the earth, tells us that God said: "Let the waters be gathered together: and let the dry land appear, and it was so done." But that King of all true scientists was far too wise and knowing to assert that all the external surface matter of the earth should, or did, become dry land within, or during the epoch of time designated as "evening and morning, one day." Much rather does he teach us that a "day," in relation to the generation of "the earth and the furniture thereof," differs widely from a day as accounted in the life of man. A brief record of the relative order in which certain evolutionary effects became maniiested. An epoch of events, rather than of time, measurable by man, which he foretold shall continue in operation so long as water exists in conjunction with the earth, in an ever-increasing ratio of velocity. And the dry land everywhere bears testimony to the absolute truth of the Mosaic science. Wherever eye has seen, and foot has trod, hill and valley alike proclaim their subjection unto water in the more or less distant past. What has become of all that immense volume of water which has left the testimony of its influence on the rounded boulders and pebbles of all lands? Has it merely changed its location? If so, to where? Or, has it not rather been changed in substance? And is not the water still remaining in conjunction with the earth ever in process of being changed from its natural form and properties to the extent of many billions of tons annually, adding that amount to the dry land, through the ordinary operations of Nature, whereby vegetable and animal forms, perpetually absorbing the watery elements, evolve therefrom their own substance, a veritable "evolution of species," much of which never again reverts to its original state and condition as water?

Inasmuch as this process of evolution has been in continuous operation, possibly during millions of years, so also it may possibly continue for millions more, but at an ever-increasing rate of progress, until water is no more. Then! What of the earth, the inhabitants and "furniture thereof?" It is not my purpose to multiply words in attempting to forecast such remote future; but prefer to leave that to the professional writer of books, and confine myself to the purpose of this article, in directing public attention to the cause tending to produce certain effects, in order to enable them to intelligently conserve the best interests of the entire community, when, and wherever menaced by ill-advised and unwise projects of the avaricious, oftimes under the specious but delusive plea of "developing the country" by enlarging, for example, existing waterways, and creating others, from these "Upper Lake" regions to the ocean, whereby their waters would be depleted at a proportionately greater rate, entirely ignoring the constant complaints—even their own—of navigators of the present existing natural channels of ever-decreasing available depth of water, not understanding or giving thought to the cause. As we have, so far, endeavored to show, the evaporative area of the water is rapidly becoming more circumscribed, so also are the retentive areas and powers of the forests and lands, whilst at the same time, congested areas of populations are multiplying between the oceans, the chief gathering-places of the rain clouds, and the drainage area of inland lakes and fresh-water storages, thus curtailing the replenishing of their waters by the amount of moisture abstracted from the water-bearing clouds coming in contact with the warm, dry air of the industrial centres. Under such circumstances, therefore, to increase the volume of outflow from these lakes, as well as others in various lands, without ensuring a commensurate increase of the supply, cannot be too strongly reprehended. Whilst, superficially, this article may seem to be more adapted for publication in the columns of a paper devoted to the exposition of abstract science and philosophy, or to one on civil engineering, rather than to one devoted to mechanical engineering it is not so in fact, inasmuch as science, civil and mechanical engineering are so intimately intercorrelated as to be inseparable. A few months ago it was reported that the great Vulcan Shipbuilding and Engineering Company had purchased an extensive tract of land on the river Elbe, to which it was about to remove its extensive works from Stettin, on the Oder, owing to the great and continuous decrease of water in the Oder, and even in the Baltic Sea, which preclude the company from

floating their vessels now, as formerly. More recent news comes to hand, to the effect that the great Salt Lake, Utah, is rapidly drying up, and causing great anxiety to that region of the State, and still more recently we learn of the recession of the Sea of Azof, leaving vessels high and dry at their docks.

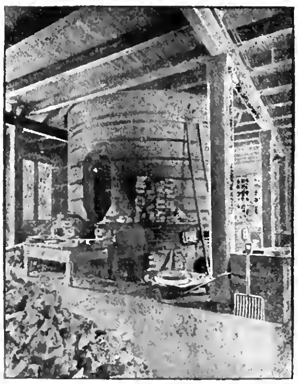
Many other instances might be cited, which tend to affect the welfare of the community in many lands, and render the returns from the expenditure of vast capital and labor nugatory.

The Toronto Globe of the 9th Dec. contained an editorial regarding the periodic lowering of the water level of the Great Lakes, "thas practically showing a continual and permanent lowering of the level." During the past year, spending some time at Collingwood, on the Georgian Bay, I was assured by an old resident that the water level there had fallen over seven feet during the past thirty-six years, say on an average of 2½ inches per year. It should then be fairly calculable how long it will take to deplete the Great Lakes below the level requisite to float a 14-ft. draft boat in the connecting channels, canals, etc.

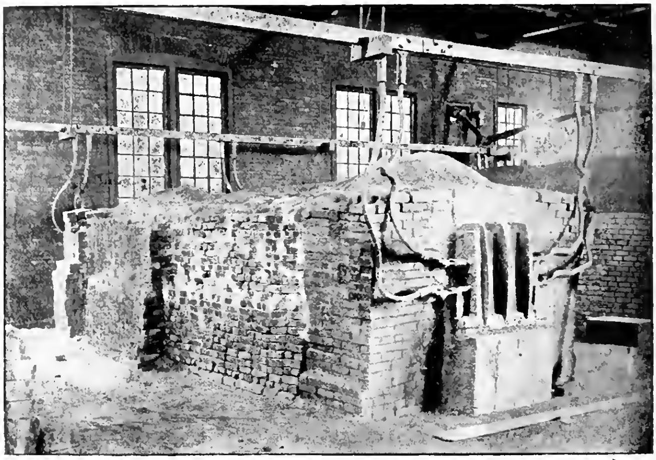
Hamilton, Ont. J. W. PAYLER.

CARBORUNDUM—ITS MANUFACTURE AND USES.

Of the many wonderful applications of electricity, none are of greater importance than that of the electric furnace, for the reason that it renders possible the production of a heat far greater than can be obtained by any other means. Under the heat of the electric furnace, steel, nickel and platinum burn like beeswax, and the best firebrick known to furnace makers is consumed like lumps of resin. It works, in short, the most incredible chemical transformations, one of the most marvellous of which is the conversion of sand and coke into a compound nearly as hard as the diamond, and even more indestructible, being less inflammable, and wholly indissoluble in the strongest acids. This compound, which is the invention of E. G. Acheson, is known as carborundum, and is manufactured at the works of the Carborundum Company, Niagara Falls, N.Y., and Ontario, Canada.



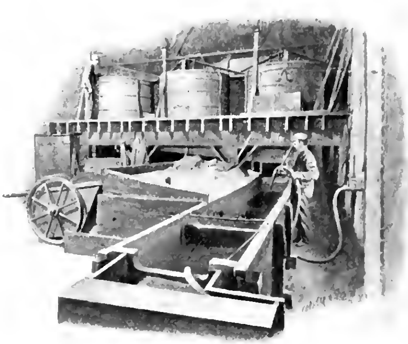
Section of Kiln Room



Carborundum Furnace Burning.

The crude materials for the manufacture of carborundum are sand, coke, sawdust, and salt. These are ready for immediate use, with the exception of the coke, which must be reduced to kernels of a certain size to be used as "core" and ground to a fine powder to be used in making the charge for the furnaces. The coke is first passed through a grinder, which breaks it up into small pieces, and is then conveyed to the upper part of the building, where it is passed successively through two cylindrical screens. The first of these removes all particles of coke which are too small to form the core, while the second allows kernels of the requisite size to pass through the meshes and fall into the core bin, conveniently situated, as regards the other constituents of the mixture. Below this bin are the scales on which the materials are weighed out in proper proportions, after which they are conveyed by an elevator to a mechanical mixer, from which the mixture, ready for use, is emptied into a bin.

The furnace room contains fifteen furnaces built of brick in the form of an oblong box, 16 feet long and 5 feet wide and deep. The ends, at the centre of which are the terminals of carbon rods, are two feet in thickness. The



Washing Carborundum Powder.

side walls of the furnaces are built four feet high, then the mixture is thrown in to a height of just over two feet, after which a semi-circular trench is formed, the bottom being a little above the level of the lowest row of carbons. The core is then put into the trench, and the top is rounded off by hand, thus making a solid cylinder 21-in. in diameter and 14 feet long, composed of small pieces of coke, extending from either end of the furnace. The walls are now built up to five feet, the mixture thrown in and heaped up to a height of about eight feet.

All that is now required is the electric current, which is supplied from the Niagara Falls Power Co., the 2,200 volt current being transformed to 185 volts. In combination with the transformer is a regulator, by means of which the voltage can be varied from 100 up to 250. The mains from the transformer to the furnace room are two copper conductors having a sectional area of eight square inches each. Heavy cables from these mains are bolted to the plates of the furnace. The circuit is completed by means of a water rheostat consisting of a circular iron vessel, containing salt water, into which can be lowered a large iron plate. To close the circuit the plate is lowered into the water until it rests on the bottom of the vessel. To break the circuit the plate is lifted out of the water. This device avoids the danger in-

volved by other methods of opening and closing circuits carrying such large currents. The resistance of the core being always greater when the carbon is cold, the voltage is first raised to overcome this. As the volume of current continues to increase, the regulation is run back, reducing the voltage, until finally the resistance of the core becomes constant and little regulation is required, the amount of power used on the furnace being 746 kilowatts or 1,000-h.p.

After the current has been on half an hour, a peculiar odor, due to escaping gases, is perceived, and at the end of three or four hours the furnace walls and top are enveloped by a lambent blue flame of carbon monoxide gas, formed by the combination of the coke with oxygen of the sand. During the run of a single furnace, five and a half tons of this gas are given off. At the end of four or five hours the furnace top gradually subsides, and fissures form along the surface out of which pour the yellow vapors of sodium. At the end of thirty-six hours, the current is cut off and the furnace is allowed to cool. Then the side walls are taken down, the unchanged mixture raked off, and the outer crust of amorphous carborundum removed. The inner crust is then removed and the crystalline carborundum, of which a single furnace yields about 7,000 lbs., is exposed.

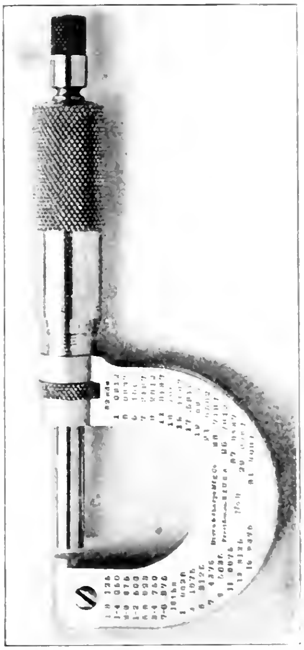
After the carborundum has been removed, it is taken to a crusher, which breaks the mass of crystals apart. Then it is taken to tanks and treated for several days in diluted sulphuric acid to remove impurities, after which it is washed, dried and graded. There are twenty grades of crystals, and three grades of flour, the latter being the fine power washings of the crystals.

Carborundum Furnace after Burning.

Carborundum is infusible, and is also insoluble in water or acid. Its hardness approaches that of the diamond, it being almost impossible with a microscope to distinguish lines scratched on plate glass by carborundum from those of the latter. Its specific gravity is 3.123, or about 20 per cent less than that of emery. The most interesting application of carborundum as an abrasive is in the form of wheels into which it is made in diameters varying from 1 to 36 inches, and in thickness from 1/4 to 4 inches, besides wheels for special purposes such as dental, cylinders, cup wheels, roll-grinding wheels, saw-gummers, moulding wheels, etc. It is also made into knife sharpeners, hones, scythe, axe and sharpening stones, cloth, paper, etc. As compared with emery, it is claimed that it will do more work, better and faster. Watchmakers use it in place of diamond. One firm found that while emery wheels would grind about 05 rolls before becoming useless, carborundum wheels would grind 220. In regard to the tendency of these wheels to burst, it is claimed that they are safer than any other class of abrasive wheels. As confirming this statement, it is on record that at a scientific test of over sixty grinding wheels, all of which were 20 inches in diameter, conducted at the Technical High School, Dresden, an ordinary carborundum wheel attained a speed of 4,340 revolutions per minute before bursting , which was the best record made by any of the sixty wheels tested. As the proper operating speed of this size wheel, is 955 R.P.M., the factor of safety is shown to be very great.

MICROMETER CALIPER CLAMPING DEVICE

Brown & Sharpe Mfg. Co., Providence, R.I., [illegible] cently placed upon the market an Improved Clamping [illegible] for Micrometer Calipers, which is much superior [illegible] clamping nut furnished heretofore. The device is simple in construction, and only a slight movement of the [illegible] ring is required to clamp the measuring spindle firmly. It is often desirable after taking a measurement to [illegible] the spindle securely in the position in which the measurement was taken for reference when a large number of pieces are to be measured. Should the spindle be rotated or moved longitudinally, the accuracy of the original measurement would be destroyed, but in the construction of this clamping device, the possibility of disturbing the adjustment is entirely avoided. Another excellent feature of this device [illegible] the tension on the spindle can be adjusted without disturbing the adjustment of the threaded portion [illegible]



out. This is a valuable feature when measuring [illegible] pieces for comparison as sufficient tension can be put on the spindle to prevent its turning when the work is passed between the measuring points, and at the same time the spindle can be left sufficiently free to allow [illegible] adjust-

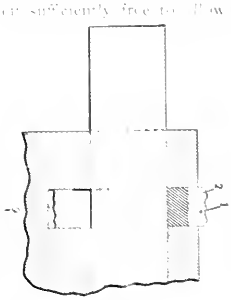


Fig. 1.

ments. When the clamping ring has been set [illegible] a certain tension, the rotation of the spindle cannot [illegible] the setting of the tension for the reason that the clamping ring is held stationary and forms part of the bearing for the spindle. Referring to the cuts, figures 1, 2, 3, and 4, the operation of the mechanism is as follows. The split clamp ring 2, figure 2, fits the measuring spindle with a sliding fit when open, thus measuring a longer bearing for the spindle than

2, which fits into a recess in the slot 9, figure 2. The roller purpose. This ring is held from rotating by the lug 4, figure 2, which fits into a recess in the slot 9, figure 1. The roller 3, figure 2, which moves upon the inclined surface cut in the periphery of the ring, is actuated by the ring 1, figure 3. The clamping ring with the roller at lowest point fits into ring 1 with a sliding fit, and as the clamping ring is held from rotating, the movement of the actuating ring to the right forces the roller up the inclined surface 5, figure 2, and closes the ring concentrically around the measuring spindle.

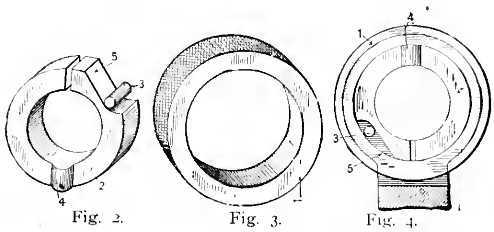


Fig. 2. Fig. 3. Fig. 4.

The slot in the caliper frame, figure 1, receives the hob rings together with the roller, and the spindle is passed through the clamping ring. It will be seen that as the clamping ring closes concentrically and as there is no opportunity for dirt or grit to get into the device, the spindle cannot be thrown out of alignment when clamping. Another feature is that the clamping ring cannot be taken out of the frame until the spindle has been run out sufficiently to clear the recess. This prevents the device from being accidentally detached or lost.

The parts are accurately fitted to prevent dirt or grit getting into them, and as the movements are so slight there is practically no wear.

CORRECTION.

In the article in last issue on the rating of Watt Meters, by Charles Brandeis, C.E., the sign ϕ was converted by mistake into an X.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

The "Mining" section of this society met on December 3rd, when a paper was read on the "Examination and Valuation of Mines," by J. E. Hardman. On December 10th, in the "General" section, a paper on the "Pressure of Grain in Deep Bins" was presented by J. A. Jamieson, which will be continued on January 28th, a discussion following. On the same evening a paper on "The Construction of the Shubenacadie River Bridge" will be read by J. J. Taylor.

THE ENGINEERS' CLUB OF TORONTO.

The members of the above club assembled on December 9th to hear a paper by J. Alex. Culverwell on "The Enlarged Erie Canal and Its Relation to Canadian Waterways." Owing, however, to the regrettable news of the fatal illness of his father, Mr. Culverwell was unable to be present, and the paper will be read at some future date. On December 17th, a pleasant evening was spent, when a lecture on "The Alaskan Boundary Question" was delivered by W. T. Jennings, M. Inst., C.E. The subject was ably dealt with from a geographical and historical standpoint, the lecturer tracing the history of the country from the date when Captain Cook, and afterwards Captain Vancouver, explored those regions, down to the present time. Many interesting facts were quoted regarding the natives of the country and surrounding islands, their mineral and forest wealth, etc. The contentions of Canada and the United States regarding the boundary line were discussed, and evidence presented in refutation of the assertion that at the recent tribunal, Canada was not well prepared with maps. The lecturer was followed by Judge Hodgins, who, in a lucid and convincing manner, presented the legal aspect of the subject, viewed from a Canadian standpoint. A hearty vote of thanks was accorded to both gentlemen, at the close. Mr. Jennings brought with him a very comprehensive collection of maps to illustrate his lecture, and also an interesting relic in the shape of a sextant, formerly in the possession of Captain Vancouver, which was the object of much attention on the part of the members. The club has recently issued a pamphlet entitled, "Bulletin No. 1," containing an interesting record of its proceedings from the date of its inception to the present time. The number and subject matter of the papers presented during this period afford ample evidence of the usefulness of this club as an educational, as well as a social institution.

LOCOMOTIVES FOR THE C.P.R.

The Canadian Pacific Railway Company, some weeks ago, ordered twenty powerful compound locomotives from the Saxon Engine Works, of Chemnitz (Sachsische Maschinenfabrik, vorm. R. Hartmann). These engines—a number of which have been delivered at Montreal—are the first locomotives ever built in Germany for a North American railway. The engines bear the Canadian Pacific Railway Company's numbers 961—980, have six-coupled wheels, each 5 ft. 3 in. in diameter, whilst the four wheels of the leading bogie have a diameter of 2 ft. 6 in., and the tender wheels are 2 ft. 10 in. in diameter. The cylinders are 22 in. by 26 in., and the steam pressure 210 lb. per square inch. The boiler, which is of large dimensions, is of the extended wagon top type, with radial stays to the firebox, and a sloping front sheet. The heating surface is as follows: "Firebox, 152.6 square feet; tubes, 2,262.9 square feet; total, 2,415.5 square feet. The grate area is 33.1 square feet. The boiler, the inside firebox, and the tank plates are well constructed of the best mild steel, the tubes are of weldless Swedish charcoal mild steel, whilst cast and nickel steel, supplied by Fried. Krupp, are largely employed in the constructional details. The tender is of the standard hopper tank type of the Canadian Pacific Railway, and has a capacity of 5,000 Imperial gallons and ten tons of coal. The electric lighting dynamo, placed just in front of the cab and driven by a steam turbine engine, supplies current for an installation of incandescent lamps, placed along the running boards over the motion, and in the cab, in addition to a powerful "Edward's" headlight. The engines, which are finely finished and are of a graceful design, are fitted with the Westinghouse-American combined air brake and a complete air signal equipment, as also the "Gold" system of steam-heating. The locomotives have been erected strictly to Canadian practice, and from the designs of E. A. Williams, the superintendent of motive power, and A. W. Horsey, the chief draughtsman of the Canadian Pacific Railway.

The Canadian Pacific Railway Company, at the same time that they placed the contracts for the 20 locomotives with the Saxon Engine Works, also gave an order to the North British Locomotive Company, of Glasgow, for a number of locomotives of precisely similar design and dimensions. The first two of the British built engines have recently been delivered, being numbered 981 and 982, and whilst the working of both the German and British engines will form a very interesting locomotive test, the introduction of the British engines into Canadian practice will also afford an opportunity of seeing whether the admitted superiority of British over American built engines is due to either design or workmanship. It has hitherto been a very rare occurrence for orders to be placed even in Great Britain for locomotives of purely American design, as are those which have recently been delivered by the North British Locomotive Company and the Saxon Engine Works to the Canadian Pacific Railway Company.—The Iron and Coal Trades Review.

Stevens & Co., Galt, Ont., makers of special tools, have extended their works by the addition of a brick building and have added a pattern-making department.

INDUSTRIAL NOTES.

A shoe factory is in contemplation at Sydney, C.B.

The Belleville Rolling Mills will be running in January.

A cement plant has been erected at Saskatoon, N.W.T.

A freight car building plant is to be erected at Digby, N.S.

R. B. McComiskey will establish a celluloid factory at Granby, Que.

The Horwood Lumber Company, Newfoundland, will erect a steam cooperage.

A foundry to make mining and cement making machinery is to be established at Galt, Ont.

The Foundry Specialty Company propose to build a factory near Ashbridge's Bay, Toronto.

The Barrie, Ont., Carriage Co. are building a factory. The foundations will be cement.

The contract for the new waterworks system, at Regina, has been awarded to Dobson, Jackson & Fry.

W. S. Dwinnell, of Minneapolis, will erect a sawmill, costing $100,000, at Edmonton, N.W.T.

The Eugene Phillips Electrical Works will construct works at St. Louis, Que., to be completed January 1st, 1905.

The Canadian Corundum Wheel Works, Hamilton, Ont., will occupy their new factory in January.

A new waterworks pumping plant has been installed at the Royal Military College, Kingston, Ont.

W. Jessop & Sons, Sheffield, Eng., steel manufacturers, may build a factory, to employ 2,000 hands, in Toronto.

It is reported that a $25,000 hotel will be erected at Portage la Prairie, Man., by McLennan & Rae, of Minnedosa.

The engine in McKee & Sons planing mill, Toronto, was wrecked by the burning of the driving belt on Dec. 8th.

The American Seeding Machine Co. will not start in Brantford, Ont., owing, it is said, to depression in the U.S.

The foundry and machine shops of F. E. Came, Montreal, were destroyed by fire on December 10th. Damage, $25,000.

The Rudd Harness Co. are removing from Toronto Junction to Parkdale, Toronto, where they are building a large factory.

The Waterous Engine Company, Brantford, Ont., have installed two large boilers, in their new power house, which is nearing completion.

The Fairbanks Scale Co., of St. Johnsbury, Vt., contemplate the erection of a plant in the St. Francis district, Que. 600 hands will be employed.

G. H. Gooderham will establish an automobile plant, occupying three flats of a five-story building, to be erected on Temperance street, Toronto.

A large planing mill and furniture factory will be erected at North Bay, Ont. Dr. Warren, Toronto, is one of those interested.

A by-law will be introduced in Galt, Ont., to assist the proposed industry of the Galt Bridge and Structural Steel company.

The Dominion Exhibition Board has handed the city of Toronto $31,029 surplus from the 1903 Exhibition, in addition to buildings, valued at $26,113.

Warden, King & Son, will erect plant and machinery, value $300,000, at Maisonneuve, Que., fronting the Chateauguay and Northern Railway line.

The galvanizing plant of the Page-Hersey Iron and Tube Co., Guelph, is in operation. It is said to be the most complete of its kind in Ontario.

J. J. Daley, of Chicago, proposes to build a 1,150,000 bushel elevator, at Collingwood, Ont. A by-law, granting $25,000 bonus, is to be submitted.

Walkerville, Ont., is making an effort to secure one of the new steel plants of the Dominion Steel Company. Another is to be built at Leamington, Ont.

Thomas Gardner, Newmarket, Ont., is [illegible] a [illegible] horse-power steam engine in his iron foundry.

The Farmers' Co-operative Harvesting Machine Company get a bonus of $20,000, and will erect a factory at [illegible]by, Ont.

F. A. Carpenter & Co., wholesale dealers in steamfitters' supplies, etc., Hamilton, Ont., offer their creditors fifty cents on the dollar.

Charles Brandeis, consulting electrical engineer, is in England consulting with a firm which proposes establishing works in Montreal.

A new industry is being opened on the north shore of the Gulf of St. Lawrence for the manufacture of fish oil, glue and fertilizers.

Boiler tubes, manometers, steel axles and principal parts used in constructing machinery are to be admitted into Peru, South America, free of duty, after April 12th next.

The National Light, Heat and Power Co., Farnham, Que., expect to turn out compressed peat shortly. The output will be 45 to 50 tons per day, and if satisfactory will be increased.

T. C. Meyers, of Johnstown, Pa., proposes to erect in Newfoundland a plant, value $500,000, to produce charcoal and gunpowder; with a pulp accessory to turn out kegs for exporting its product.

Niagara Falls, Ont., has declined to entertain the proposal of the Cullen-Johnson Brass Mfg. Co., to establish works there. They asked a $20,000 loan, with free power, water, light and taxes.

South Sharon, Pa., is to be made the greatest tin plate producing centre in the world. The American Tin Plate Company are erecting the plant to consist of seventy pot mills, employing 6,000 hands.

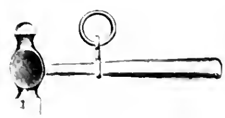
The Sunbeam Incandescent Lamp Co. of Canada, McKinnon Building, Toronto, are issuing a watch charm and stick pin in the form of miniature incandescent lamp. The company's factory is at St. Catharines, Ont.

A book, entitled "Worth Knowing," containing an amount of valuable matter for engineers will be sent free on application to the Union Petroleum Co., Toronto, Canadian representatives of the Keystone Chemical Co., of Camden, N.J.

The Electro-Manganese Co., Shawinigan Falls, has started making ferro-manganese, by the electric reduction of bog ores from the Lower Provinces. The plant uses 1,200 horsepower from the Shawinigan Water and Power Company, and this will be increased, if the works prosper, to 5,000 this year.

The jury, in connection with the fatal explosion at the United Factories, Limited, Newmarket, Ont., exonerated the management and employees from all blame. No cause for the disaster could be arrived at. The new boiler and the engine have been installed, very little time being lost on account of the explosion.

In addition to the watch charm recently advertised, the Mechanics' Supply Co., Quebec, are introducing an attractive little novelty in the shape of a machinist's hammer, which they will be pleased to forward, post paid, to any one on receipt of Canadian or United States stamps value thirty cents.



The Dodge Manufacturing Company, of Toronto, Limited, has completed its immense undertaking of furnishing special machinery and castings for the Harbor Commissioners' million bushel elevator, at Montreal. Some 250 tons of machinery and castings from the company's plant at Toronto Junction have been supplied, and the work has been approved of by the contractors, Government inspectors and engineers. The huge steel marine leg, which has been successfully hung in the tower, is said to be the largest in Canada.

Mica Boiler Covering Co., Limited, 86-92 Anne St., Montreal, have been appointed agents for James McCrea & Co., Chicago, and carry a complete stock up to 12 inches of the Climax Steam Joint Clamps, manufactured by that company. They are in a position to fill all orders immediately on receipt.

For the better distribution of its products, the Dodge Manufacturing Company, of Toronto, Limited, manufacturers of the celebrated Dodge pulleys, and many other lines now prominently on the market, will open commodious quarters at 419 St. James street, Montreal. A competent staff will have the new branch in complete running order by January 15th.

The Goldie & McCulloch Co., Galt, Ont., have installed a light and power plant in their factories, comprising 400 incandescent lights, 80 arc lamps, and a number of Bullock variable speed motors. The motors are geared direct to large lathes and planers, and are reversible, and can be run at any speed by means of a controller within reach of the machine hand. Current is generated at 250 volts, direct current, but through the medium of a balancer is delivered to motors at three different voltages. The firm furnished their own material and the entire plant was installed by H. F. Strickland, Toronto.

C. M. Rudel, late of the American Tool Works Co., of Cincinnati, has accepted the position of machinery department manager of the Fairbanks' Company, for Canada, with headquarters at Montreal. When connected with the Cincinnati firm, Mr. Rudel had charge of the railway business and contract department. He has been identified with the machine-tool business for some time, and the experience and ability which he brings into his new position will no doubt result in still further augmenting the rapidly increasing business of this progressive firm.

The Fairbanks Co., 41 Front Street West, Toronto, have been awarded the contract for the installation of a steel waggon scale, to be placed in the roadway directly west of the King Edward Hotel. As traffic would be constantly passing over this scale, and as it is about thirty feet above the floor of the boiler-room below, the problem presented was somewhat difficult, but it has been satisfactorily solved. A coping of 18-in. "I" beams around the scale is provided, to which the corner irons of the scale are rivetted. The scale levers hang from these corner irons; and a novel protection device is added in the shape of structural steel material hanging from the coping just below the levers of the scale, so that if at any time, through accident any of the pivots of the scale should break, there will be no danger of the scale dropping through to the basement below. The scale platform, of structural steel, is built by means of "I" beams running in both directions, and the whole platform is covered with ⅜ inch boiler-plate, on top of which are put asphalt paving blocks, the top platform of the scale being on an angle to conform to the curvature of the roadway. The double beam will rest on a short iron pillar outfit in the boiler-room below. The total weight of steel and iron in this scale is over 9,000 pounds.

The Westinghouse Company have secured, through Westinghouse, Church, Kerr & Co., an important export order from the Manila Construction Company, an American corporation, operating in Manila, P.I., for a complete city traction power equipment, comprising the following machinery: Three 750-K.W. Westinghouse turbo-generator units, two compound engine exciter units, one motor-driven exciter unit, three 500-K.W. rotary converters, one 300-K.W. rotary converters, four 250-K.W. oil-insulated transformers, complete switchboard, and one series booster mounted on the extended shaft of one of the rotary converters. The car equipments will comprise ninety double No. 68 C. outfits, and ten double No. 56 outfits, using standard Westinghouse controllers. The first turbo-generator unit will be delivered in about nine months. The turbine will operate at 150 lbs.' steam; 26-in. to 27-in. vacuum, and 150 deg. superheat. It is fitted with the usual by-pass for securing an overload capacity of 50 per cent. It is also equipped with a quick-closing throttle valve. The turbo-generators will furnish three-phase, 60 cycle current at 380 volts; part of the current will be converted to D.C. by the power house railway sub-station, and the remainder will go to transformers for supplying high-tension distributing system. The transformers are oil-cooled and connected in the two-phase, three-phase, or Scott system for three-phase transmission. The turbine machinery will also furnish current to the local light and power system.

MINING MATTERS.

The Brookfield Mining Co. will erect a cyanide plant.

The Oderin copper mine, Newfoundland, will be worked in the spring.

The Pugwash River Company, of Gloucester, Mass., will develop copper areas at Upper Pugwash, N.S.

The Dominion agent, at Birmingham, is enquiring for mica boiler coverings and asbestos in large quantities..

The McDonald corundum mine, near Palmer Rapids, Ont., promises a big yield. P. Kirkegard, Delora, Ont., is manager.

Cape Breton, N.S., has six collieries under the water, Broad Cove, Mabou, Port Hood, Old Sydney, Sydney No. 2, and Newcastle.

The Acadia Coal Company are sinking two shafts at Ford Pit, N.S. They also will build a wharf at Pictou Landing to cost $40,000.

The New Brunswick Petroleum Company, Limited, of Moncton, will erect a refinery with a capacity of 300 barrels a day, at Memramcook.

L. Merritt, of Duluth, is exploiting for iron ore on Hunter's Island. In the spring drills will be put in operation if the best test pits warrant it.

It is stated that the antimony mines, at West Gore, N.S., will employ one hundred men at the beginning of the new year. An up-to-date plant has been installed.

An important discovery of asbestos has been reported to the Bureau of Mines by Willis Brown, of Buffalo. The property is in the township of Kaladar, Addington County.

It is reported that garnets, opals, and tourmalines have been found near Lac du Bonnet, forty miles from Winnipeg. An expert says the clay formation is the same as at Kimberley, and diamonds may yet be discovered.

Councillor Stoness, of Kingston, Ont., reports a movement on foot to extend the northwest branch of the Rideau Canal from Tett's Mills to Desert Lake. This will open up a large zone of mica, phosphate, iron, and feldspar beds.

Fire destroyed the machine shop of the Rarig Engineering Company, at Sydney Mines, last month. Loss, $30,000, and two hundred men out. The company was constructing blast furnaces for the Nova Scotia Steel Company. All the machinery was ruined.

The Craig mine, near Bannockburn, Ont., will run again soon. The Rand Drill Co., of Sherbrooke, Que., are installing a compressor plant, boilers, hoists, etc. A 20 ton stamp mill will be erected next spring. W. A. Hungerford is superintendent.

The Deputy Commissioner of Mines states that from present indications, the find of nickeliferous copper at Cheticamp in the northern part of Cape Breton will rank among the largest copper mines in the world. The ore appears to be an almost solid mountain of mineralized rock, the ledge rising over a thousand feet.

A new lead smelting plant has been installed at Bannockburn, Ont., by the Ontario Mining and Smelting Company.

One hundred and fifty coke ovens are now in operation at Morrissey Mines, B.C. The remaining hundred will be completed in the spring.

The annual convention of the Canadian Institute of Mining Engineers will be held at the King Edward Hotel, Toronto, from March 4th to 6th next. Eugene Coste is president.

The mine at Cordova, Ont., has been closed down for investigation, the company in England having become dissatisfied with the management. It is reported that work may be recommenced again in the spring.

A company with a capital of 1,500,000 rupees (about $750,000), is being formed in Calcutta, India, to develop a very rich copper mine recntly discovered in the Himalayas. Seventeen American mining engineers are prospecting in that district.

Reports of the Nova Scotia Coal and Steel Company show the coal output at Sydney to be 80 per cent. greater than last year, and at Marsh mines 75 per cent. It is estimated that 700,000 tons will be produced next year. The steel output has also increased.

The shaft of the Iron Mask mine, Kamloops, B.C., will be sunk another 200 feet, and to equip the mine with the necessary machinery, plant, valued at $100,000, has been ordered, mostly from Canadian houses. A concentrating plant of 200 tons daily capacity will be erected.

John Galt, C.E., reports a discovery of anthracite coal near Banff. A company will commence operations at once. The C.P.R. has let contracts for a spur line to the pit mouth, including extensive sidings. This discovery, it is stated, should cut the present price of anthracite ($12 to $14 per ton), in that district, in two.

J. L. Greatsinger, ex-president of the Brooklyn Rapid Transit Company; Peter Kimberley, Sharon, Pa., and associates, have proved a valuable copper mine 65 miles west of Port Arthur, Ont., and 14 miles south of the C.N.R. It is said much of the ore is 30 per cent. copper, and carries $11 in gold per ton. A smelter will be erected.

The International Coal and Coke Company, Coleman, Alberta, have placed contracts for plant to maintain an output of 2,000 tons daily. The Westinghouse Company will supply the electrical equipment, including motors, generators, locomotives, etc. The boilers and structural steel will be purchased in Canada.

I. Matheson & Co., New Glasgow, N.S., have installed a new tandem compound engine at the Sydney Mines plant of the Nova Scotia Steel and Coal Co., for operating a Capell mine fan. The fan has a diameter of 20 feet, and making 150 revolutions per minute, supplies 200,000 cubic feet of air at a 5½-inch water gauge pressure.

The Granby Consolidated Mining Company, Granby, B.C., propose to drive a tunnel into the foot of the mountain, four miles from Phoenix, and 4,000 feet below it, until it reaches a point directly under the mines, and to excavate from the tunnel upward. This will greatly reduce the cost of mining and eliminate the expense of hauling freight cars up the mountain. The work, for which legislation has been applied, will take some years to accomplish.

H. DeKeyser, who has erected a test furnace at Vancouver, B.C., of 50 tons daily capacity at a cost of $13,000, has threatened proceedings against Dr. Hendryx, should he establish works at Republic and the Arlington mine, alleging that the latter's process is an infringement of his invention, which has been patented in all countries. The DeKeyser company will, when satisfied with the present test, build a 5,000-ton per diem smelter.

P. B. Ball, Government agent in Birmingham, Eng., for Canada, states that the Welsh, Scotch and English mines are using Swedish, Norwegian, French and Spanish pit props, and he sees no reason why Canada should not share the trade. Two million tons of pine a year is used. He will try and interest some Canadians in Welsh coal, and if so, the return journey with pit props would reduce freight. They are now 17s. to 19s. per ton, ex-ship, Barry or Cardiff.

Rich veins of gold-bearing quartz are reported at Webbwood, Ont.

Pyrites, carrying 40 to 50 per cent. sulphur, have been found in the Steep Rock district, Ont.

The new Science Building, in Toronto, will contain departments of mining engineering, applied chemistry, mineralogy and geology, and will include a small blast furnace for smelting iron, a stamp mill, ore-crushing rolls, a reverberatory roasting furnace, and a special equipment in ore-dressing machinery. A room is provided for the geological museum, to contain the combined collections of the School of Science and the University, under Professors Coleman and Walker.

A company has been organized to exploit the corundum fields of Eastern Ontario. They have secured 600 acres in Raglan, Renfrew County, and will erect one of the largest corundum plants in the world. Connected with the project are: W. B. Rankin, president Canadian Niagara Power Company; H. P. Coburn, Sawyer-Massey Co., Hamilton; J. H. Tilden, Gurney-Tilden Co., Hamilton; J. H. Jewell and H. H. Dewart, Toronto, and a number of Buffalo and New York men. Mr. P. Kirkegaard will be manager.

Representatives of the New York and Ontario Mining Company and New York and Canadian Copper Company, comprising H. Seibert, of the Brooklyn Upper Transit, president; H. Inman, of the Inman Company; W. W. Flower, of Flower & Co.; Ira Kipt, Jr., of the New York Stock Exchange; S. W. Albrey, and H. Folger, late secretary to Senator Flower, have been visiting their properties in the Rainy River District, seventy miles north of Port Arthur. They state that the gold and copper workings will prove the most valuable in Ontario. A stamp mill and smelter will be working by March 1st.

The Government has appointed a commission to go to Europe to inspect the various electric processes for the smelting of iron ores and the making of steel. The commission consists of Dr. Haanel, Superintendent of Mines, and C. E. Brown, of the Canadian General Electric Co. A steel expert and a draughtsman will be selected in Europe to assist them. The Italian Government have successfully experimented with water power for electric smelting. At Livet, France, what are known as the Harmet and Keller processes are in use, and at Gysinge, in Sweden, steel is made from scrap and pig iron by electricity. In electric smelting, a purer pig iron and a better class of steel are obtained.

TELEPHONE AND TELEGRAPH.

The M. Welsh telephone line, Bristol, N.B., has been extended to Florenceville.

The telephone system between Blyth and Auburn, Ont., is now in working order.

Edmonton and Calgary, N.W.T., are now connected by "Bell" long distance lines.

The Vernon and Nelson Telephone Co. have spent $10,000 in improving the system at Phoenix, B.C.

The Bell Telephone Company has reduced the rates in residences at Cape Vincent, Ont., to $12 a year.

John Peverley has purchased the wires and instruments of the telephone service between Cartier and Geneva Lake, Ont.

The New Brunswick Telephone Company have connected St. John with Andover and Grand Falls. The company's long distance service, with the exception of Restigouche, Gloucester, and Madawaska, covers all the counties in the province.

Nesbitt, Gould & Dickson, Hamilton, Ont., have entered action to quash the civic by-law giving the "Bell" Co. an exclusive franchise on the ground that the Provincial Legislature has no power to authorize the city to grant such a privilege, and further, that it creates a monopoly restraining trade and commerce. It is also alleged that unlawful means were used to influence the passing of the by-law.

The residents of Hall's Mills and Union Hall, Ont., propose to extend the Clayton telephone service to their locality, and those interested will contribute liberally to the scheme.

The Toronto World states the farmers ten miles north of Guelph have a system, with phones costing $2.50 each, and wire proportionately low, maintenance costing $1 a year.

The Canadian Telephone and Telegraph Co. will apply to Toronto for a franchise early in the year. The rates are not yet announced. The same company also want a franchise in London, Ont.

The Nova Scotia Telephone Company's long distance line, between Halifax and Sydney, has been completed to Port Hawkesbury, and will connect with Sydney early in the year.

A long-distance telephone line is being constructed from St. John, N.B., to Fredericton, via Belleisle Narrows, White's Cove and Chipman. It will be completed next spring.

Ahearn & Soper, of Ottawa, are building for the Government a telegraph line from St. Peter's to Scatarie Island, N.S., via Gabaruse, Mainadieu, Scatarie, and North Sydney. It will be completed shortly.

To keep the 30,000 odd miles of telegraph line in order in Great Britain, and provide for the proper despatch and delivery of millions of messages every month costs about $11,250,000 a year, including $7,500,000 for salaries.

Long distance telephone communication was inaugurated on December 15th, between the Kamouraska Telephone Company's exchange, at River-du-Loup, Quebec, and Toronto, 600 miles distant.

Willian von Siemens, of the Siemens-Halske Company, Dr. Franke, Dr. Thomas, and Dr. Erkhardt have completed, after several years' work, a new telegraph instrument which will transmit 2,000 words per minute over long distances. Perforated paper ribbon is used in the apparatus, and the message is received on a strip of sensitized paper, which emerges with the letters fully developed.

H. A. Bryan, a labor organizer, stated at Fort William, recently, that he had acted as agent for the Bell Telephone Company to discredit the town's civic management, and so influence municipal elections against local telephone systems. He asserted that the company supplied him with a petition asking for Government audit of municipal accounts. He implicated Capt. Hilmes, and Mr. Scott, of the Bell Company, in the matter. The general superintendent admits that the petition was circulated with the company's approval, but denies the assertion regarding municipal elections.

RAILWAY NOTES.

W. Anderson, secretary of the Hamilton and Caledonia Electric Railway, states that work will be commenced early in the spring, the power houses at Caledonia and Indiana, Ont., being started first.

An order-in-council has been passed canceling the order of Sept. 7 last, remitting temporarily the duty on certain materials of Canadian manufacture used in the construction abroad of locomotive engines for railways in Canada.

Henry O'Sullivan, C.E., and Sirois, C.E., are surveying the territory for the line of the Gaspe Railway. Mr. Sirois is working between Paspebiac and Port Daniel, while Mr. O'Sullivan is on the Gaspe section in the direction of Barachois and Perce.

A new surface contact transportation system was tested recently in Atlantic City. The inventor is Leon W. Pullen, of Philadelphia, . His system eliminates the third rail, overhead wires, poles, open conduits, and cables. A large trolley car carrying 100 people was used for the experiment. Beneath the car is attached a series of magnets which make the contact as they pass over the boxes, which are in the centre of the tracks, 16 feet apart. In appearance the contacts are like inverted saucers and are alive only at the time of the passage of the car over them. It is claimed eighty miles an hour can be attained.

The C.P.R. will erect a palatial hotel, costing $500,000, on the James' Bay flats, Victoria, B.C. F. M. Rattenbury is the architect.

The Stonewall, Man., Gazette says: Rumor has it that application will be made at the next session of the local house for a charter to build an electric line from Stonewall to Winnipeg. Several local men are interested, and there is a fair prospect that the rumor may materialize.

A petition is being circulated between St. Jerome and St. Sophie, Que., asking for a loop line from St. Antoine to Charlemagne, taking in the towns of St. Anne and Mascouche. This extension to the Great Northern would open up a new bit of country, and would give a more direct route from the West.

The North Lanark Railway Company will shortly begin to make surveys. The route proposed is from the High Falls on the Madawaska to Arnprior, thence to Galetta and Fitzroy Harbor, and thence to Ottawa. James Bell, of Arnprior, secretary, states that there is no truth in the report that an effort will be made to sell the charter.

LIGHT, HEAT, POWER, ETC.

The Hull Electric Co. propose developing a water power and lighting plant at Quyon, Que.

The first eight months' working of the Edmonton, N.W.T., municipal electric light system showed a profit of $3,069.

Capitalists represented by Mr. Van der Voort, of Toronto, propose to develop power at Petawawa and transmit electricity to Pembroke, Ont. A franchise is applied for.

Ottawa citizens obtain electric light for eight cents net per 1,000 watts. This is understood to be the lowest rate in Canada, and is due to competition and water power facilities.

Sherbrooke, Que., will apply to the Legislature for power to submit to the whole electors, instead of the ratepayers only, a by-law for the loan of $200,000 to instal a municipal electric lighting plant.

Capitalists represented by Mr. Dingman, of Toronto, propose to exploit natural gas at Edmonton, N.W.T. The council will grant a franchise on certain conditions, providing work is commenced in six months.

J. E. Doyle, of Hamilton, Ont., has been fined $25 for using the current of the Cataract Power Company without their knowledge. His service had been discontinued owing to a dispute, but he reconnected it.

The Electrical Development Company, Niagara Falls, Ont., will erect for the Toronto and Niagara Power Co. one of the largest power houses on this continent. It will be of solid granite, 425 feet in length, 200 feet wide, and will cost $400,000. E. J. Lennox, Toronto, is the architect. Tenders will be called for immediately. A gallery will run round the building, from which visitors can see the plant in operation and view the Falls.

The finding of the jury in connection with the acetylene explosion at Ridgetown, Ont., was to the effect that the disaster was due to an escape of gas through the V-shaped water seal, and contributory negligence of the attendants. Further, the machine was not of a type in accordance with the specifications of the Canada Fire Underwriters' Association, and it was recommended that Parliament enact legislation to isolate acetylene gas plants and place them under Government supervision.

Legal proceedings have been taken to quash the two by-laws passed by the Peterborough, Ont., town council granting franchises to the Light and Power Co. and the Radial Railway Co. on the ground that another company tendered to do the lighting for ten years at $1,500 per annum less; hence the town is indirectly giving a bonus of $14,000 for the introduction of the railway. Judge Meredith made an order quashing the electric light by-law, and the motion regarding the railway company was adjourned to enable the council to amend it. The council has amended the electric light by-law, but will appeal the decision regarding the railway.

The Montreal city council have received a report from Charles E. Phelps, chief engineer of the Electrical Commission of Baltimore, placing the entire cost of putting all wires in the city underground at $1,205,100.

The electrical committee of the Toronto city council have adopted a by-law and agreement to govern the municipalities interested in the municipal power scheme. The agreement provides: 1. For the confirming of the commissioners in their appointment, R. A. Ross, electrical expert included. 2. For the payment to R. A. Ross a sum of not over $1,500, the other four commissioners to serve free. 3. For the apportionment of the cost of the report, according to the assessment of the municipalities interested. 4. That the total cost of the report should not exceed $15,000. 5. That in case of death or resignation of any of the commissioners their places could be filled by others. 6. That the agreement shall not come into effect until seven municipalities were pledged to the scheme, Toronto included. The combined assessment of the other six municipalities to be at least $36,000,000. The by-law is merely to authorize the execution of the above agreement.

MR. GOSSLER RETURNS TO NEW YORK.

P. G. Gossler, general manager of the Montreal Light, Heat and Power Co., will go to New York in the spring, where he will be general manager of the operating department of J. G. White & Co., the large electrical and engineering contractors, who are doing a part of the work of the big Pennsylvania Railway tunnel, and who operate electric lighting and power systems in Manila and Porto Rico, as well as in the United States. Mr. Gossler takes his new position at a considerable advance over the salary received in Montreal. Coming to Montreal in 1895, as engineer and superintendent of the power department of the Royal Electric Co., he was retained with increased powers when that company was amalgamated with the Canadian General Electric Co., and later merged into the present large corporation. His management of the larger concern, with its varied interests and intricate requirements, has been as signally successful, as in the case of the smaller company. This is a striking testimony to the abilities of so youthful a manager, when it is borne in mind that Mr. Gossler had not only to deal with many questions in the operating department that were new to Canada, but had recently to face serious labor difficulties which were settled with less than the usual irritation arising from wages disputes. In the Canadian Engineer for July, 1899, a biographical sketch was given of Mr. Gossler, from which it appeared that when only twenty years of age he had taken the responsibilities of assistant chief engineer for the United Electric Light and Power Co., of New York. Mr. Gossler, who is only now in his 33rd year, was last year president of the Canadian Electrical Association, being the youngest man, so far elected to that position. No successor has yet been decided upon to take his place in the Montreal Light, Heat and Power Co.

P. G. GOSSLER.

General Francis V. Greene, of New York, has been appointed general manager of the Niagara and Ontario Power Company, Niagara Falls, Ont. He will have full power to direct the company's affairs at the new plant now building on the Canadian side of the border.

PERSONAL.

Albert A. Honey, of Chicago, inventor of the underground trolley, is dead.

J. W. Leonard, assistant C.P.R. manager for lines west of Winnipeg, has resigned.

Arthur M. White, civil engineer, of St John's, Nfld., died suddenly in Boston last month.

H. S. Williams, Sarnia, has been appointed superintendent of the Guelph, Ont., gas works.

P. D. Brunnelle, a well known steamboat inspector, died last month at Quebec, aged 74.

Beuth Sims, recently engineer of the Ottawa and Northern, has been appointed resident engineer of the C.P.R., at Regina, N.W.T.

John Watson, sr., founder and president of the John Watson Manufacturing Co., died at Ayr, Ont., on December 14th, aged 84.

R. A. Ross, electrical expert, of Ross & Holgate, Montreal, has been appointed fifth member of the Ontario Municipal Power Commission.

Robert Grimes, formerly president of the Elmira Bridge Company, and one of the most noted bridge builders in the country, died on December 12th.

W. P. Roper, manager of the Charlottetown Light and Power Co., has resigned, to be assistant manager of the Montreal General Electric Co.

E. A. Williams, superintendent of rolling stock for the C.P.R., has accepted a position with one of the big American roads.

I. McMichael has been appointed general manager of the Great Northwestern Telegraph Company. He was forty years in the service of the Western Union Telegraph Company.

Frank T. Craven has resigned his position with the C. J. Field Conduit Company to represent the American Conduit Company of 170 Broadway, New York, Chicago, and California.

Capt. Albert H. Clinton, manager for twelve years of the large fleet of the D. B. I. and W. Ferry Company, died on Dec. 11th, aged sixty years. The deceased was born in Ancaster, Ont.

E. H. McHenry, engineer-in-chief of the C.P.R., has been appointed by Sir Thos. Shaughnessy to represent that company in connection with the new railway department, at the McGill College.

W. G. Ross, second vice-president and director of the Montreal Light, Heat and Power Company has resigned. Senator L. J. Forget is elected a director, and Rodolphe Forget second vice-president.

H. F. J. Porter, assistant manager of the publishing department of the Westinghouse interests for the past year, has been made second vice-president of the Nernst Lamp Company, of which enterprise George Westinghouse is president.

L. J. Forget has resigned the presidency of the Dominion Coal Company, and is succeeded by J. H. Plummer. It is also announced that H. M. Whitney, vice-president, has resigned, and retires from the board of directors. He is succeeded by J. Reid Wilson, of Montreal.

Sir Frederic Bramwell, F.R.S., D.C.L., LL.D., the eminent engineer, died on November 30th, at the age of 85. He was president of the British Association in 1877, and was one of the earliest advocates of the treatment of large steel forgings by hydraulic pressure.

Graham Fraser, recently a director and manager of the Nova Scotia Steel and Coal Co., is now general manager of the Dominion Iron and Steel Company.

F. W. Wanklyn has resigned the positions of vice-president and general manager of the Montreal Street and Montreal Park and Island Railways. K. W. Blackwell will, it is understood, replace Mr. Wanklyn as vice-president of these companies, while W. G. Ross, the present secretary, will become managing director. Duncan McDonald will be the manager of the two systems, and P. Dube, secretary.

George S. Hodgins, for many years connected with the mechanical department of the C.P.R., the latter part of the time as locomotive inspector, and afterwards mechanical engineer for the Canadian Locomotive Co., Kingston, has been spending the Christmas holidays with his father, Dr. J. George Hodgins, librarian of the Ontario Education Department, Toronto. Mr. Hodgins is now associate editor of Railway and Locomotive Engineering, New York, in which vocation he has brought to bear an extensive practical experience of all questions relating to motive power.

F. T. Wilkes, sec.-treasurer of the Waterous Engine Works Company, Brantford, Ont., died suddenly from paralysis, on Dec. 17th. Deceased was in his 56th year. He was the son of Judge Wilkes. He went to Brantford thirty-five years ago, entering the employ of the Waterous Company. Here he gained in a large measure the practical business ability which in after years contributed so greatly to his success as controller of enormous industrial interests. In the local Board of Trade he was a prudent adviser and a regular attendant at all the meetings. He leaves a widow, and three sons.

T. C. Frenyear, sales manager of the new Canadian Westinghouse Co., died of typhoid fever at Fort William, Ont., on December 10th. Deceased was the son of the Rev. T. C. Frenyear, and was born at Middleton, Vt., on March 16th, 1865. He began business with the Boston Electric Company at the age of 15, serving subsequently with the Thompson-Houston and Brush Electric Companies. From 1892 to 1895 he was superintendent of the Cayadutta Electric Railway, resigning that position in 1895 to enter the service of the Westinghouse Electric & Mfg. Co., with whom he remained until Nov. 1st last, when he was placed in charge of the sales department of the Canadian Company. In conveying news of the death to the officials of the Westinghouse Company, Vice-President Taylor said: "The management desires to place on record its thorough appreciation of his able and loyal service and of the loss to the Westinghouse interests by the untimely removal of a young and zealous official, whose future seemed so full of promise." A widow and three children survive him.

RADIUM.

Sir Wm. Ramsay's recent lecture before the London Institution on "Radium and the Periodic Law" was perhaps chiefly remarkable for his declaration that the transmutation of elements as a theory was by no means absurd. The lecturer briefly sketched the outline of the periodic law, which is beginning to suggest some root identity between the various elements, and then told of some practical results that had followed the discovery of this law. Sir William traced the various steps which led to the discovery of radium. Mendelieff, the great Russian chemist, ranged the elements—hydrogen, oxygen, carbon, nitrogen, sodium, the metals, and the other substances of which all things were composed—in the order of their atomic weights. Thus arranged, he showed that substances which came in certain classes had certain properties in common, as, for example, flourine, chlorine, iodine, and bromine. But there were gaps in this scheme, and Mendelieff predicted that new elements would be discovered to fill the vacant spaces. The fulfilment of that prophecy was one of the greatest scientific achievements of recent years, and each new kind of atom had fallen into and fitted an empty place. In 1894, Lord Rayleigh and Sir W. Ramsay detected argon in the air. Next year Sir William discovered helium, which had been revealed in the sun by the spectroscope before it was found on earth. Two years later, 1897, when the British Association met in Canada, Sir William Ramsay ventured on the prophecy that other elements like argon and helium would be discovered. He and a scientific colleague justified the forecast. They searched high and low, and finally by means of liquid air they isolated three new elements in the atmosphere—krypton, neon, and xenon—belonging to the same class as helium and argon, and like them inert bodies with no discoverable affinity for others. The professor showed what gases of these substances were like by sending through them an electric current. Their spectra were thrown on the screen, that of xenon, or "the stranger," showing in its entirety the remarkable number of 2,000 distinctive lines. These, it had been said, were inert elements. Their discovery had been followed by the revelation of a class of elements that were remarkably energetic. In 1896 Rontgen discovered the X-rays, and Prof. Ramsay showed a radiograph, the first taken in London by the Rontgen rays. Simultaneously, Becquerel, in Paris, discovered that uranium would discharge the electroscope. Madame Curie, following up the investigation, revealed the existence of polonium in pitchblende, and in the same mineral Monsieur and Madame Curie made the momentous discovery of radium—now universally known as the most energetic of all radioactive bodies. But not the only one; there seemed to be six in all—uranium (found by Becquerel), polonium and radium (Monsieur and Madame Curie), thorium (Schmidt, of Breslau), tinium, and an unnamed element (by Gresel). As to what became of radium ultimately, Sir William gave it as his opinion that the infinitely small particles that it threw off eventually lost their radioactivity, and then gave the spectrum of helium. It seemed as if this intensely active element at last turned into helium—thus bearing out the theory of transmutation.—Electrical Engineer, London, England.

CALENDARS FOR THIS YEAR.

We have to acknowledge with thanks the receipt of serviceable calendars for 1904 from the following firms: B. Greening Wire Co., manufacturers of wire rope and wire cloth, Hamilton, Ont.; M. Beatty & Sons, manufacturers of dredges, hoisting machinery, and contractors' plant, Welland, Ont.; Kerr Engine Co., makers of power pumping machinery, hydrants, and valves, Walkerville, Ont.; Ashton Valve Co. valves and gauges, Boston, Mass.; Hale Bros. publishers Orillia Packet, Orillia, Ont.; Mutual Life Insurance Co., New York and Montreal; Daniel Kahnweiler's Sons, makers of life-saving apparatus, 437 Pearl St., New York; The Pittsburg Meter Co., East Pittsburg, Pa., makers of gas and water meters; The Royal Insurance Co.

The Robb Engineering Co., of Amherst, N.S., have installed a new boiler for the Fredericton municipal electric light system, recently purchased from the local company.

—Christmas fires were responsible for the following losses: J. Inglis & Co., Toronto, pattern shop and offices, $40,000. The National Table Factory, Owen Sound, $60,000. Aitchison's sash and door factory, Hamilton, $20,000. The Canada Cabinet Co., Gananoque, Ont., dry kiln, $10,000. The Moose Jaw Machine Works, N.W.T., $5,000.

Col. McMullen, of New York, president of the Ottawa River Railway Company, representing American capital, proposes to construct an electric railway from Ottawa to Montreal, through Argenteuil, Two Mountains, Terrebonne, Laval, and Jacques Cartier counties, with branches to St. Rose, St. Ann and St. Genevieve. They offer to sell ten tickets for twenty-five cents for local city service. The cost is estimated at from $10,000 to $13,000 a mile. The directorate is composed of F. D. Monk, M.P.; T. W. Raphael, Thos. Christie, M.P.; J. A. Ethier, M.P.; J. E. Leonard, M.P.; Thomas Gauthier, and Mr. Wells, of New York.

A new supplement to catalogue No. 77 has just been issued by Arthur Koppel, manufacturer of narrow gauge railway materials, 66-68 Broad Street, New York. The supplement gives further data concerning the firm's standard track materials, mainly switches and turntables. These data will assist in making up plans for tracks in large buildings, factories, boiler rooms, etc. A copy of this supplement will be sent to all interested parties mentioning this paper.

THE EVOLUTION OF THE TELEPHONE EXCHANGE.

BY F. DAGGER, TORONTO.

One of the most convincing arguments employed by telephone companies, in support of the high rates charged to subscribers in large cities, is to the effect that the cost of construction and operation of large telephone systems increases at a ratio far greater than that of direct proportion to the number of subscribers. To the mind of the average business man, whose experience teaches him that the greater the quantity produced, the cheaper the cost of production is, this argument seems to be totally opposed to reason; yet, the telephone manager fully realizes its truth from actual knowledge of the facts.

The cause of this increased cost is to be found in the central office equipment, where it is necessary to provide not only for the terminals of the subscribers' lines, but to so arrange the switchboard that each individual operator can, by a movement of the hand, connect the calling subscribers on her section with any one of the total number of lines on the exchange. For example; on an exchange of 5,000 telephones, an operator to whom is allotted the duty of attending to the calls of 80 subscribers, must have within arms' length 5,000 jacks or connecting springs, into which she can insert the plug attached to the cord connecting with the calling subscribers of her section of the switchboard. In order to accomplish this the switchboard is divided into sections, each of which comprises 200 answering jacks, and a number of connecting jacks equal to the total capacity of the exchange. Thus: on the switchboard of 5,000 lines there would be 25 sections, each containing 5,200 jacks, or a total of 130,000.

A 10,000 line switchboard would be divided into 50 sections, or 10,200 jacks each, or a total of 510,000, while an exchange into which all the subscribers' lines in New York were concentrated, namely, 100,000, would necessitate 50,-100,000 jacks, a problem which would stagger the most sanguine telephone engineer.

In consequence of this unalterable law of multiplication in connection with the growth of a telephone exchange, it is generally conceded that when the capacity of a manual switchboard exceeds 5,000 lines, it becomes too expensive and too complicated to provide a good service at low rates.

In large cities the general practice has been to divide the city into sections, and to place in each section an exchange of 5,000 lines. For the purpose of connecting the subscribers throughout the whole system, trunk or junction wires have to be provided between the exchanges, and, in order to provide a prompt service, these trunk wires should be equal to 20 per cent. of the total number of lines on the system. This entails not only an increased cost of construction, but more complicated apparatus, and a large number of expert operators to handle the traffic over these trunk wires, in addition to the ordinary operating staff.

In view of the additional expense attached to all this, it may be said that the telephone charges of the independent companies in large cities in the United States have touched "rock-bottom" figures, and with respect to manual switch boards, these have reached the maximum of perfection as regards their ability to handle economically large numbers of subscribers.

Recognizing the fact that, if the use of the telephone was ever to become of universal benefit to the community, it would be necessary to eliminate the ever increasing expense which the manual operating of a large telephone exchange involves, inventors have been at work since 1879, endeavoring to devise a system which would connect telephone subscribers without the meditation of the "hello girl," or in other words, to produce a telephone-operating machine.

The development of automatic telephony has been necessarily slow, and although much has been done experimentally, in the past, it has remained for two natives of the birthplace of the "Bell" telephone, Messrs. J. H. and G. W. Lorimer, of Brantford, Ont., to produce a machine which, while costing less to manufacture than a manual switchboard, will perform all the functions [illegible] exchange, with a promptness and decision [illegible] any manually-operated system in the world.

The operating machine comprises a number of sections each accommodating 100 subscribers. On each of these sections are five connecting divisions, any one of which automatically performs the same functions as a telephone operator handling a pair of connecting cords. In combination with each section is a "Decimal Indicator" and "Division Starter," which control the section to which they belong, and pilot each subscriber's call to an idle division, which completes the connection with the subscriber called.

A remarkable feature of this exchange is, that should the whole of these divisions be in use when a call is made, it is stored until the release of one of the divisions, when the waiting call is completed without any further effort on the part of the calling subscriber; hence, no call once made is lost nor neglected.

Each section is capable of handling 360 calls per hour, and inasmuch as the average calls per 100 subscribers, during the busiest hour of a large exchange, is computed to be 125, it will be seen that this machine can deal with traffic far in excess of known requirements.

The number of connecting divisions can, like the connecting cords of a manual switchboard, be arranged to meet the traffic requirements of an exchange. The percentage of cords of a manual exchange is usually ten per 100 subscribers, which enables 20 subscribers out of each hundred to converse at one time. In exchanges where the traffic is light, this number may be reduced, and where it is heavy the percentage is increased. This principle has been carefully followed in the "Lorimer" system, thereby enabling the maximum of service to be given at the minimum of cost.

The connecting divisions being for the common use of all subscribers it is only necessary to provide a sufficient number for each section to fulfil the demands of the service at the busiest hour of the day. The experience of manual exchanges proves that in the majority of cases ten, or even a less number of divisions in a section are sufficient. Hitherto it has been found necessary, in other automatic systems, to provide a set of individual connecting apparatus for each subscriber, with the result that at all times 90 per cent. of the apparatus of the exchange was always out of use. For this reason such systems are so costly and complex that they offer little inducement to the telephone companies to discard the manual system, but by the saving of the 90 per cent. of apparatus effected in the "Lorimer" exchange, the end of the manual switchboard is in sight.

Another point in this machine worthy of special mention is the fact that every line on the exchange is tested once in four seconds without intermission, and if a line becomes out of order, the fact is at once announced by the ringing of an alarm, when the attendant in charge can at once locate the faulty line, and isolate it until the defect is right.

Each section of the machine is completed at the factory, and is sent out fully wired and tested as an individual unit, thereby enabling the capacity of a telephone system to be increased or diminished by adding to or taking away any number of sections, without interfering with the working of the exchange. The wiring between each section is so simple that a youth with the merest elementary knowledge of wiring could complete the connections between any number of sections without assistance. This is an advantage absolutely unattainable by the builders of manual exchange equipments.

The subscriber's outfit consists of a long-distance central energy telephone set, in combination with which is an automatic device for transmitting the impulses necessary to operate the central machine. These impulses are controlled by four pointers, working on an indicator plate, arranged to be moved up or down four vertical rows of numerals, representing units, tens, hundreds and thousands. These pointers may be set to indicate any number from 0 to 9999. For instance, if 4,567 is wanted, the pointers are set thus: in the thousands row, at 4; in the hundreds at 5; in the tens at 6; in the units at 7. The subscriber then pulls down a

lever, which releases the automatic signal transmitter, and when the lever regains its normal position, he removes the receiver from the hook, rings the subscriber called by pressing a button, and commences the conversation. Should the number wanted be engaged, the calling subscriber is aware of this by the fact that as he presses the button he cannot hear the alternations of the ringing current in his receiver, which would be perfectly audible if the line wanted was not in use.

This exchange is adapted for "central energy" working, and can be installed in connection with existing telephone systems without necessitating any interference with the plant outside the central office.

One of these exchanges is in operation on the premises of the Canada Machine Telephone Company, who are the owners of the patent rights for Canada. Arrangements have been completed for the establishment of a large plant in Toronto for the manufacture of these machines.

WATER POWER FROM GLACIERS.

An interesting case of water-power development from glacial streams is illustrated in the Chicago Western Electrician. The power is to be obtained from mountain glaciers, which yield a continuous flow the year round. The plant is now in course of construction at Electron, and the water is to be taken from a stream thirty-five miles from Tacoma, 1,900 feet above sea level, and within nine miles of the first glacier. In all five glaciers feed the stream. A large dam will be constructed and the water will be diverted through an 8-ft. square flume, cut through solid rock, and suspended across canyons, a distance of more than ten miles, to an elevated and precipitous bank of the stream, where a large reservoir is to be constructed. The water will be conducted at a decline of 7 ft. to the mile, and at the end will be dropped at an angle of 45 deg. through steel pipes 1,700 ft. in length down the slope to the river bank, a fall of 888 ft. and a pressure of 400 lb. to the square inch being secured. The reservoir is to be provided in order to cope with fluctuations in the stream, and as a reserve power in case of accidents to the flume. With a fall of 888 ft. the water will rush down through penstocks of steel and strike the buckets of the waterwheels of which there will be nine, at a velocity of 240 ft. a second. From 3,000-h.p. to 4,000-h.p. will be developed. The work is being hurried on as much as possible, and a temporary electric lighting plant has been installed, so that operations may be continued night and day. A great part of the electric power developed will be used in the operation of about seventy miles of electric tramways, but the company will have a surplus of from 10,000-h.p. to 20,000-h.p. above the requirements of its own lines, which will be sold for industrial purposes. The Electrical Engineer, London, commenting on this enterprise, says: Experience with harnessing glacier-fed rivers on the Continent has proved that there is want of water during hard winters.

COBALT-NICKEL DISCOVERIES IN ONTARIO.

The recently discovered deposits of cobalt-nickel in North Ontario are of great importance. Like the great nickel deposits of the Sudbury, they were the outcome, not of a search for minerals, but of blasting out a railway cutting. The present deposits were disclosed during the building of the Temiskaming and Northern Ontario Railway, and the road runs over some of the veins. They lie five miles south of the village of Haileybury to the north of Lake Temiskaming, about 106 miles north of North Bay, and ninety miles northeast of the Sudbury nickel mines.

The discovery is the subject of an interesting article in the Engineering and Mining Journal, by Prof. W. G. Miller, provincial geologist of Ontario. He says: "When I visited the locality recently, four veins or deposits had been located in the vicinity of a small body of water, known as Long Lake. Each of the four veins visited was found to carry cobalt. Nickel also appears to be present in all of them; but as the weathering of the cobalt compounds masks at times the nickel colors, this latter metal was not definitely recognized in two of the deposits, although it doubtless occurs wherever the cobalt is found. Three of the veins are rich in native silver. Very little work has been done on any of the veins, and as the surface is pretty well filled by moss and soil, it is impossible to state what is their horizontal extent. All of the veins cut through one or both of the formations known in the district as Huronian slate and breccia-conglomerate."

The ore has a massive appearance, and a rather dark grey color, where not coated with cobalt bloom. When examined in hard specimens, especially if a polished surface be examined with a magnifying glass, it is seen to be a mixture of a grey material, which is chiefly nickelite, and the reddish material, niccolite. Minute, brilliant silver-white or tin-white crystals occur sparingly, embedded in the wall-rock, and in the ore. The crystals occur in cubes, and in combinations of this form with the pyritohedron. The ore is somewhat porous, spaces being left between the globules, which are tarnished almost black on their surfaces. Where not coated with cobalt bloom, the weathered surface of the ore has a dark color, not unlike that of the wall rock. On a fresh surface the more massive ore resembles unspickel, but is somewhat darker in color.

The ore of Sudbury is of a different character from that of the Haileybury deposits, being essentially pyrrhotite and copper pyrite. The rock associated with the Sudbury deposits, which are not veins, but deposits of irregular shape, is norite, a variety of gabbro; the ore itself is claimed by most writers to be of igneous origin. There is little in common between the ore bodies of the two localities, except that nickel is the chief metal of each. On the Quebec side of Lake Temiskaming, about nine mines to the northeastward of the Haileybury deposits, there is a deposit known as the Wright silver mine. This was discovered many years ago by some of the early explorers of that region. During recent years this deposit has been worked for its lead and silver contents. The deposit is unique in character, the wall rock being Huronian breccia-conglomerate, the fragments of which are, at times, cemented together by argentiferous galena.

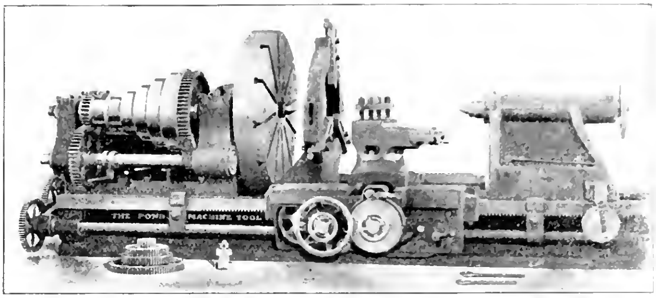
Cobalt is used in the arts, chiefly in the form of oxide. It is obtained from New Caledonia, Australia, and Germany, and smelted in France, Germany, and Great Britain. Cobalt oxide is produced at one plant in the United States. The ore of New Caledonia, which is the world's largest producer, shipping about 3,000 tons yearly, is cobaltiferous wad, containing from 25 to 30 per cent. manganese and 2 to 8 per cent. of cobalt oxide. The ore of New South Wales is similar in character. In both countries the cobalt ore is a decomposition product, and occurs in irregular deposits, similar to those of bog iron ore..

At the end of 1901 and the beginning of 1902 the price of cobalt ore, containing 4 per cent. cobalt, in New Caledonia was fixed up higher than circumstances warranted. The black oxide of cobalt sells at from $2.26 to $2.30 per pound, or the metallic cobalt in the compound brings about $5 per pound. It would thus seem that the refiners should make a much larger profit than the miners. The market will not, however, stand a greatly increased production without the prices materially decreasing. It is claimed that there has been a combination among refiners to keep up the prices of the artificial cobalt products.

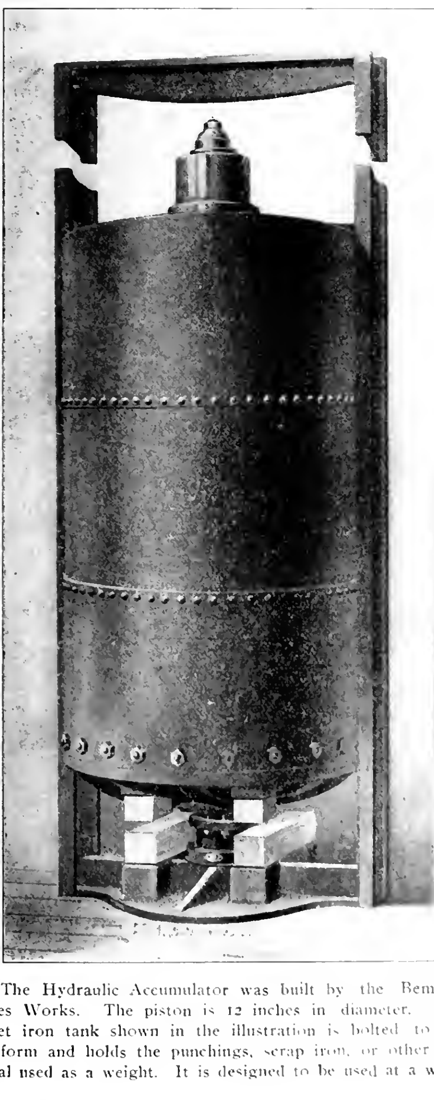
NILES-BEMENT-POND LATHE AND HYDRAULIC ACCUMULATOR.

Referring to the recent description of the Montreal Locomotive and Supply Co. Works, the following is a description of the 54-in. lathe and the hydraulic accumulator supplied for those works by the Niles-Bement-Pond Co., of New York: The 54-in. lathe is one of the company's standard lathes, built by the Pond Machine Tool Works. It swings over bed 55-in. and over carriage 45½in. with 16½-ft. bed will turn 6-ft. 4-in. between centres. The spindle is of large diameter and has twenty changes of speed.

The spindle bearings are lined with bronze. The carriage is fitted with compound swiveling tool slide, and has screw cutting attachment, and longitudinal, cross and angular feeds. The feeds are entirely independent and their direction may be changed at the carriage. The bed is of box



form and wide enough to prevent the tool over-hanging the front when turning full swing on the lathe. This lathe is designed for use of modern high-power tool steels and is an especially powerful machine.



The Hydraulic Accumulator was built by the Bement-Niles Works. The piston is 12 inches in diameter. The sheet iron tank shown in the illustration is bolted to the platform and holds the punchings, scrap iron, or other material used as a weight. It is designed to be used at a water pressure of 1,500 lbs. per square inch. It has [illegible] at the base, and a rod is provided for regulating the action of the pump. The use of an accumulator in an hydraulic plant is of an immense advantage, as the pump may be of comparatively small size and run continuously, the accumulator furnishing the sudden demand for water. In the accumulator, illustrated below, the sheet iron tank as it moves up when water is pumped in, is held in position by guides.

MAJESTIC ARCHITECTURE.

Miles of Magnificent Buildings for World's Fair Uses. Facts about the Exhibit Palaces.

St. Louis, Mo., when the gates of the Louisiana Purchase Exposition swing open on April 30th, 1904, an achievement which reaches the highest climax in the display of art and industry, will mark an epoch in the history of civilization.

In immensity this Exposition far excels all others ever dreamed of during any nation's progress. This World's Fair of 1904, occupies one thousand two hundred and forty acres, situated on the beautiful undulating ground of the far-famed Forest Park. A few comparative figures reveal this wonderful immensity at a glance. The World's Columbian Exposition, at Chicago, covered 633 acres; the Exposition of 1900, at Paris, 336 acres; the Pan-American, at Buffalo, 300 acres; the Centennial, at Philadelphia, 236 acres, and the Trans-Mississippi, at Omaha, 150 acres. So, it is seen, that the World's Fair of 1904, at St. Louis, embraces within its boundaries an acreage equalling three-fourths the aggregate of all these named, and is equal in size to the Columbian Exposition, the Paris Exposition, of 1900, and the Pan-American, combined.

Pursuing these comparative figures further, it is seen that the roofing of the main exhibit buildings at St. Louis covers 128 acres, while Chicago had but 82 acres; Buffalo 15, and Omaha, 9. Any one of the four single buildings at St. Louis embraces more exhibit space than was found in the entire Pan-American Exposition. Then, too, the Louisiana Purchase Exposition introduces an elaborate feature which was practically slighted in all other expositions, and that is the large space devoted to outdoor exhibits. These open-air displays cover more than 100 acres at St. Louis and many of them challenge the indoor exhibits for popularity and attractiveness.

However, while the scope of the World's Fair of 1904 comprehends the art and industry of the entire world of to-day, yet it is not an Exposition of "dead" products alone, but pre-eminently one of life and motion. Beside the finished products, the hum of whirling machinery is heard, as skilled workmen from the four quarters of the globe are busy showing how these products are made. The World's Fair of 1904 stands uniquely alone in this phase of activity.

The first impression of any Exposition is produced by the architectural outline of the buildings. And in this feature the Louisiana Purchase Exposition has never been excelled. The main group of Exposition palaces, twelve in number lies in the northwestern portion of the grounds. These buildings are arranged in a way to take the best pos-

sible advantage of Nature's gifts and make the rolling hills harmonize completely with the architectural plan of the Exposition. Other writers have aptly described this plan as one suggesting the lines of a fan. From a central point on the summit of the dominating hill stands Festival Hall, midway in the semi-circular colonnade of the States, which stretches away 750 feet on each side. Sixty feet below, eight of the magnificent palaces are situated along radiating avenues that correspond to the ribs of the fan-like formation. These cascades rush down the terraced hillside and are lost in the Grand Basin below. Lagoons wind among lawns and flower gardens across this fan-like formation, and ornamental bridges adorn the broad avenues of travel.

The Colonnade of the States is 52 feet high and over a quarter of a mile in length, bearing sculptural images symbolical of the twelve States and Territories formed from the Louisiana Purchase. At the ends of the Colonnade are circular restaurant pavilions 130 feet in diameter and 140 feet high, each surmounted by a dome. The Festival Hall, in the centre, 200 feet high and covering two acres, is surmounted by an impressive dome overlooking the scenes of activity in the entire Exposition.

On one of the radiating avenues below the hill, where stands the Festival Hall, is situated the Palace of Education and Social Economy. It is on the east side of the main lagoon, facing the Grand Basin. This building is of the Corinthian style of architecture. Its ground plan is in the form of a keystone. The two equal sides are 525 feet long, the south front 460 feet and the north front 758 feet. The principal entrances are upon the axes of the building, and resemble triumphal arches. At each angle of the building is a pavilion forming a supplementary entrance, and these are connected by a monumental colonnade. The four elevations are similar in character, and a liberal use of monumental and historical sculpture lends a festal character to the otherwise somewhat severely classical exterior.

The Palace of Electricity, also facing the Grand Basin, excels in the majesty of its proportions and the beauty of its architectural details. It is entirely surrounded by lagoons crossed by ornamental bridges. It has a frontage of 758 feet toward the north and 525 feet toward the east, and is also in the shape of a keystone, the design being a bold columnated treatment of the Corinthian order. The facades are well accentuated by eleven pediments with groups of columns and tower effects, affording opportunity for the ample sculptural decoration. The fenestration is bold and appropriate, giving ample light, and on top two sides of the building the loggias add pleasing effects of light and shadow. This palace covers eight acres, and cost $399,910. It was designed by Walker & Kimbell, of Boston and Omaha.

The Palace of Manufactures is of the Corinthian order of architecture, and faces the entrance to the main boulevard. It has a frontage to the north of 1,200 feet, with a depth of 525 feet, and covers 14 acres. It was designed by Carrers & Hastings, of New York, and cost $720,000. The four main entrances at the centres of the main facade are elaborately ornamented with sculptural groups, etc.

The Varied Industries Palace is a magnificent structure on the outer perimeter of the picture representing the main plan of the Fair. The visitor is awe-struck at the magnificence of this building when he passes through the main entrance gate of the Exposition. It presents a facade of 1,200 feet on the north and 525 feet on the east, giving nearly 14 acres of exhibition space, all on the ground floor. It is a columnated design embodying a free treatment of the Ionic order. Aside from the numerous entrances on the facades, there is a specially featured entrance at the centre of the south front. This entrance is thrown back and magnificent colonnades formed on either side. Van Brunt & Howe, of Kansas City, are the architects.

One of the most imposing and artistic structures ever erected is the Palace of Liberal Arts, designed by Barnett, Haynes & Barnett, of St. Louis. It cost $500,000. It is 750 feet long, 525 feet wide, and covers nine acres. While the style of architecture is a severe treatment of the French Renaissance for the exterior facade, it will adhere very closely to classic lines in many respects. The long facade, especially, will show a magnificent entrance, almost pure Corinthian. It has been the endeavor of the architects to depend largely on sculpture in the decoration of the building, refraining from the over-use of stereotyped architectural ornamentation. The long main facade is made interesting by the use of a centre pavilion and of two end pavilions. The centre pavilion is brought somewhat above the connecting buildings, which unite it with the pavilions on either side. Each of the three pavilions, on the fronts, forms an elegant entrance to the building. On the main facade are three entrances and on the 525-foot facade are two entrances, one in each of the end pavilions. The main entrance is in the form of a hemi-cycle, with circular colonnades. The ceiling of this hemi-cycle is frescoed on a background of old gold.

The Palace of Machinery, designed by Widmann, Walsh & Boisselier of St. Louis, is 1,000 by 525 feet in area, and covers ten acres. It cost about $600,000. The architectural style is the fully developed Italian Renaissance. The main order is the Corinthian with the columns, accordingly, plainly treated in the shafts. This building is a model of grace and beauty, and has a prominent place on the western arm of the main transverse avenue of the Exposition. The north facade of this palace stretches east and west one thousand feet, and has a magnificent centre pavilion flanked by two great towers, the topmost pinnacle of which reaches skyward 265 feet. The southern facade is accentuated by four ornate turrets. The east facade has a tall, massive centre pavilion 300 feet long, flanked by two short curtains of lower elevation, conforming to those on the north facade, and terminating in the ornate corner towers. The western facade, 300 feet long, has two corner pavilions surmounted with high and graceful towers. Two massive piers rise from the foundation to the cornice top, losing their massive appearance there and terminating in pointed turrets bearing long and slender flag-staffs. These massive piers and the corner pavilions carry the three great archways, each 48 feet wide. The main entrance in the north facade presents an arcade of five bays, the massive piers of which are highly ornate. Above the three central bays rises an Attica feature, accentuated by pairs of Corinthian columns between which are three large panels. The Palace of Machinery presents on each side an entirely dissimilar design and contour, and this is owing to the architect's plan of departing from the rectangular shapes adopted in the other exhibit palaces in the main picture. Thus the building possesses a diversity of architectural features not accorded to any of the other great buildings.

The Palace of Transportation, designed by E. L. Masqueray, Chief of Design for the Exposition, is 1,300 feet long by 525 feet wide, and covers over fifteen acres. It cost more than $700,000. The facades show an admirable adaptation of the French Renaissance style of architecture. On the east and west fronts are three enormous arches, taking up more than one-half the entire facade. Each arch is 64 feet wide and 52 feet high. The decoration is found principally in the impressive massing of large details, and the general treatment is extremely simple. The building reminds one of a great railway station, as through the massive archways run 14 railroad tracks.

The Palace of Art surpasses the structures devoted to art exhibits at all previous expositions. This palace really comprises four massive buildings, the aggregate frontage of three of them is 836 feet, the two side pavilions having each a depth of 422 feet. Their cost is over $1,000,000. The plan of the palace is in the shape of a capital "E," the open part facing the south. The central building, 340 feet long by 160 feet wide, is of stone and separated from the side pavilion, made of brick and staff, by avenues 44 feet wide. The central building is a permanent structure. The Sculpture Pavilion on the south is 150 feet long by 100 feet wide, its plan being rectangular with an exedra or semi-circular bay at the east and west ends. The interior of the quadrangle is laid out as a garden for flowers, shrubs, fountains and statuary. The Art Palace stands on Art Hill to the south of and above Festival Hall. The main facade of the structure fronts north toward the main picture of the Fair.

The group is designed in the graceful Ionic style, accentuated at the main entrance of the central building by a Corinthian order of majestic proportions, thus giving the structure the characteristic appearance of an art building. To the centre of the main building rises a pedimented construction to a height of 40 feet. The architect of the three larger structures is Cass Gilbert, of New York, while E. L. Masqueray designed the Sculpture Pavilion.

The Palace of Agriculture is 1,600 feet long, 500 feet wide, and covers 20 acres. It cost $529,940. It was designed by E. L. Masqueray. The fronts of the building are practically a successive series of windows, each 75 feet long and 27 feet high, each window being placed 14 feet from the floor, so as to allow the use of the wall space inside for exhibits. Triangular monitor windows supply skylight, while they cut off the direct sunlight, which would quickly spoil many exhibits which this building will contain. The grand nave, 106 feet wide, which runs through the entire 1,600 foot length of the building, rises to a height of 60 feet and supplies what is here regarded as the grandest vista of installation space of any building ever designed for exposition purposes. Some idea of the immensity of this building is obtained when it is known that the Madison Square Garden, of New York, covers only two acres, and that the Palace of Agriculture is ten times as large, and that this palace also covers twenty times as much ground as the hotel Waldorf-Astoria, forty times the space covered by the Planters' Hotel, in St. Louis, and is more than three times the size of the Coliseum of Rome.

The Palace of Horticulture, designed by E. L. Masqueray, is 800 feet long, the main central section being 400 feet square. The east wing of the building is a conservatory 204 by 235 feet in area and 40 feet high, the west wing having the same proportions.

The exhibits of Forestry, Fish and Game are in a building having a frontage of 300 feet north and south, and 600 feet east and west. This building and those devoted to Agriculture and Horticulture are in line south of the Administration Building.

The Palace of Mines and Metallurgy is 750 feet long, and 525 feet wide, and covers about nine acres. It is 60 feet high to the cornice. It cost about $500,000. It was designed by Theodore Link, of St. Louis, the designer of the St. Louis Union Railway Station. This building is situated in the southwest portion of the grounds, and is the largest structure provided, thus far, for mining exhibits at an exposition. The entrance shows Egyptian style, but the building in its entirety is an expression of the modern Renaissance. The building is divided into eight oblong parts almost equal in area.

The building for the exhibits of the United States Government is the largest structure ever built by Governmental authority for any exposition. In size it is 800 by 250 feet, and $450,000 were set aside for its construction. It occupies a commanding site in the extreme eastern part of the World's Fair grounds. Southeast of it lies the high plateau on which are situated various State buildings. The Government building faces to the northwest, overlooking the main picture of the Fair. On the terrace in front of the building a flight of steps, 100 feet from side to side, leads through a flower garden to the main entrance. The general style of the building is Pseudo Classic. The central pavilion, surrounded by a broad dome, is connected with pavilions on the ends with a colonnade of Ionic columns five feet in diameter and 45 feet high. The central pavilion, with the colonnade on either side, forms a portico 15 feet wide and 524 feet long, 50 feet above the level of the other buildings. An attic 15 feet in height, embellished with statues, surmounts the colonnade of Ionic columns. The dome surmounting the central pavilion is 100 feet in diameter, and is designed after the Pantheon at Rome. The top to the quadriga, which surmounts it, is 175 feet above the ground. The building was designed by James Knox Taylor, supervising architect of the Treasury Department. He also designed the Government Fisheries Pavilion, situated south of the Government Building, and connected with it by a grand stairway. This pavilion, 135 feet square, is a reproduction, line for line, of a Roman dwelling h[illegible] type.

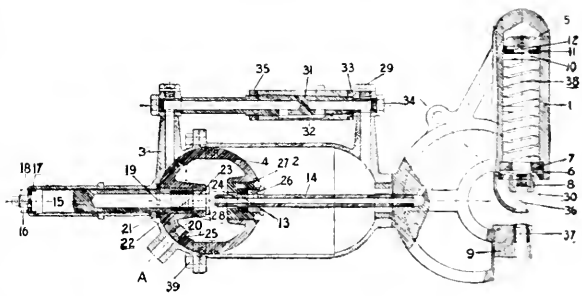
The various magnificent Palaces of the Louisiana Purchase Exposition are all part of a harmonious scheme worked out by the architects assembled together as a commission. The style adopted is described as "A free treatment of Renaissance."

A half million dollars is being spent for the sculptural adornment of these buildings and the grounds, and the genius of the architect and the sculptor and the painter will be fused into one harmonious picture the greatest exposition achievement of all time to open the twentieth century.

A. C. C[illegible]

CASKEY PNEUMATIC PUNCH

This device, recently placed on the market by the Chicago Pneumatic Tool Co., 1010 Fisher Building, Chicago, is another of the constantly increasing examples of the successful application of compressed air to mechanical work. The first Caskey punch ever built, while of crude design and entirely different from the finished product of the market to-day, actually punched 90 per cent. of the holes in two torpedo boat destroyers. It was not until two years later that these machines were placed on the market, and the interim was devoted to perfecting and improving them. Their legitimate field is apparently unlimited, but they are of particular value in the machine shop, and a glance at the illustration will bring to the mind of the engineer, foreman or superintendent, numerous cases where such a punch would prove economical. Portability, speed, accuracy, lightness of weight, and convenience are a few of the numerous advantages they possess. The method of operation is as follows: The ball piston, No. 4, carrying tail rod or intensifier 15, is seen in extreme rearward position, the extremity of the stationary hollow rod 14, being at the approximate centre of the ball piston, when the piston begins its stroke, impelled by the constant air pressure from A, the rod 14 telescopes into tail rod 15, and by this movement effectually seals all communication between the tail rod and the exterior of the piston proper. As the piston and rods 14 and 15 are kept filled with oil, it will be apparent that the entire air pressure back of the piston is concentrated upon the column of oil contained in rod 14, and the passages leading to the punch ram chamber. Further, the volume of oil so moved at each stroke being just sufficient to depress punch 30 the proper distance, as soon as the hole is punched no further downward motion is possible. It will be evident that all jarring and undue strain on the parts are thus prevented, and a steady, yet positive action gained. When the piston has completed its working stroke, a slight turn of the valve 32, admits the air to the other end of the cylinder, thus equalizing the air pressure on both sides of the piston; but the area of the stationary rod 14 being less than that of the tail rod 15, the ball piston is forced back into position for another stroke. A great saving in air consumption is effected by this arrangement, the same air being utilized to drive the piston in both directions. Owing to the peculiar construction and arrangement of the ball piston and parts co-acting therewith, it is impossible for any air to get into the high pressure passages, unless the oil level in piston [illegible]



permitted to fall below the top of the opening in the tail rod, when the piston must be refilled at once. A great drawback incident to the use of some hydro-pneumatic tools, is thus entirely eliminated. In the construction of some parts, an alloy of aluminum is used to secure lightness.

FOR THE STEAM ENGINEER.

The Montupet water-tube boilers have been subjected to tests on French warships. It is found that the tubes can be very quickly removed and replaced. In one of the trials, which lasted four hours, the fires were reduced, the steam pressure lessened, the boilers emptied, and a tube removed—all in the space of 15 minutes. The tube was then replaced and the steam pressure immediately restored. The total interruption to the proper working of the boiler lasted 40 minutes, and of this only eight to ten minutes were employed in removing and replacing the tube. Later, when the fires were out and the boiler had cooled, 32 tubes were removed in one hour and twenty minutes. All the tubes were found to be in good condition.

The use of zinc to prevent the oxidation of the iron and the incrustation in steam boilers has greatly increased during recent years. Heretofore, zinc has been employed for this purpose only in the shape of raw pigs, but after many experiments made by the society of "Mines et Fonderies de Zinc de la Vieille Montagne," which have since been confirmed by the British Admiralty, by the national French marine, and many great maritime companies, it has been established that compressed laminated zinc made in the form of thick plates for application as an inside boiler lining is greatly superior to the old method. In fact, the galvanic current developed transforms the pig of raw zinc into a more porous substance, in which the metallic molecules are insulated one from the other by the corrosion which is quickly produced, resulting in this, that the intimate metallic contact, which causes the generation of the electric current, is eliminated. Compressed laminated zinc, on the contrary, resists the spongy internal corrosion, as it corrodes only on the surface, thus being very slowly consumed and being capable of conducting the current as long as a metallic nucleus remains. The application of the laminated plates is very simple. They are applied to the walls of the boilers by means of strips and are so distributed that the galvanic action is exercised in an even way, when possible, over the entire surface of the iron. When oxidation is produced in any part of the boiler, it is because the nearest zinc plate is too far away. By this employment of pressed zinc the incrustation of the boilers is avoided, and at small cost.

The methods of disposing of city refuse are costly and wasteful. There is an immense amount of power in the refuse which might be turned to account if proper methods were employed. In Great Britain, by the use of what are called destructors, the stuff is converted into fuel at such a high temperature that no gases escape to infect the surrounding air, and everything is consumed but a small residuum that has in some cases been used as a filtering material. The temperature is carried as high as 2,000 degrees Fahrenheit The bulk of the fuel is the refuse itself, and the heat is converted into power, just as coal might be, to run pumping engines and electrical plants for lighting and traction. These destructors are of various types and their use is rapidly extending.

It is the custom of some engineers to shut all of the valves in their plants at night, while others only close those that are absolutely necessary. Some close all valves on their lubricators, others only shut off the supply of oil. Both think they are right, but the one who shuts all never regrets his action, while he who does not sometimes finds a glass broken, and damage done by hot oil thrown around promiscuously. One experience of this kind usually is sufficient to show him the error of his ways. The same difference in practice is found about shutting off water columns when leaving them at night, for while one engineer will carefully shut them off every night, another leaves them just as they are used. After a man has come into his boiler room in the morning and found that a broken gauge glass has allowed water and steam to be blown into it during the greater part of the night, he usually decides that it is a good plan to shut the valves before he goes away. This certainly is the safest way, and the only objection to it that we have heard of is that he may forget to open them in the morning and find out where his water-level is.

As a rule, the cross compound engine is more desirable than the tandem where uniform speed is essential because it has two cranks set at right angles, therefore the force is supplied to the crank shaft in a nearly uniform manner, which prevents the changes which are inseparable from a tandem compound or a simple engine, where the whole of it is applied to one crank.

WHAT CONSTITUTES A GOOD BOILER FURNACE?

In order to burn the fuel as most firemen like to see it burn, the total air space of the grate must be as large as possible, while the metal is reduced to the smallest size consistent with ample strength. The surface of the grate will be smooth, offering no obstructions to the use of the slice bar and rake. A furnace in which a long time is required for the perfect combustion of the fuel will be made larger, as well as the combustion chamber and flue. Where a high temperature is desired, sufficient air must be supplied, and to realize this, both time and space become important factors if thorough combustion is had. The walls of the furnace will have very few openings, such as doors and vents, because every break in the solid wall increases the tendency toward cracks, which can seldom be avoided entirely, and which cause air leaks that interfere with economy. The walls will be built double with an air space of ample size between them, so that any air that may leak through the outer half of the wall will become more or less heated before reaching the furnace, and will thus tend to aid rather than hinder combustion. The furnace will be lined with a quality of fire-brick combining great refractory power with hardness, and a degree of toughness sufficient to resist the abrasion due to the fire tools and the clinker. The lining of fire-brick will extend from two to four feet beyond the bridge wall, depending upon the size of the boiler and furnace, beyond which ordinary brick will be used. The walls will be firmly held together by suitable anchor bolts because neither fire-clay nor mortar is entirely reliable for binding the brick together and especially when subjected to the high temperatures of the furnace. All joints between the boiler and the walls will be kept tight—as nearly air tight as possible—by means of a properly built wall and suitable filling material between the constantly moving shell and the walls, and lastly, the space back of the bridge-wall and the floor of the ashpit will be paved, which not only makes the furnace work better, but enables the fireman to work better also.

THE HOT WATER METER FOR BOILER EVAPORATIVE TESTS.

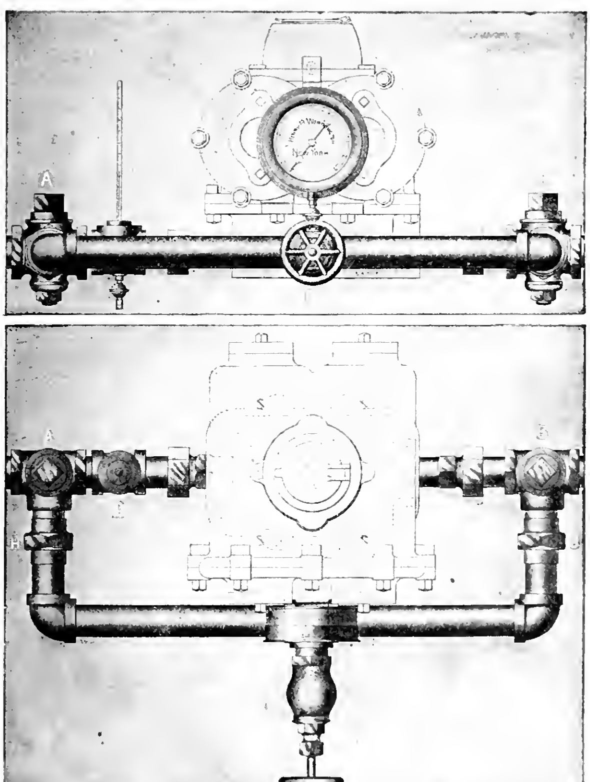
BY JOHN A. DREW.

Every engineer, who has control of a boiler plant, must feel the necessity of having some simple device by which the amount of water fed to the boiler can be accurately measured. With such an appliance, it is easy to test the evaporative values of various coals.

There was a time when it was not necessary to keep a close record of the cost of operation of large power plants, but now the ever-increasing competition and the necessity of lowering the cost of production demand the very closest scrutiny into every possible source of economy. With the introduction of electricity and the consequent installation of large central power stations, and in large manufacturing establishments, where the cost of power is an important item in cost of the product, a very careful record should be kept of the performance of the boiler plant, and there are but few, if any, plants to-day that do not keep a close record of the coal consumption. But while this is valuable information in itself, it is only part of the data that should be obtained. If the amount of water evaporated is not known, there is no way of separating the performance of the boiler

itself from the balance of the plant. This separation shows when the boiler is affected by scale or soot, and determines the most economical fuel, as well as the best method of firing, either by hand or by mechanical stokers. In the past, the customary method of determining the amount of boiler feed water has been by weighing or measuring it. This is a very laborious method, even for short tests, and is utterly impracticable for daily work. The use of the feed water meter, on account of its simplicity, accuracy and reliability in evaporative tests, is now adopted by engineers for daily work, as well as for trial tests.

The most reliable test meters are of the positive displacement type, the duplex pattern of which measures water by means of two chambers alternately filled and emptied by the motion of their pistons. These meters are so constructed that it is impossible to pass water without a corresponding registration, for in order to pass through the meter, the water must be displaced by the motion of the pistons and therefore recorded by the counter attachment. The pistons are closely fitted and move in parallel lines. The design, arrangement and construction of valves and parts is such that the strokes of the two pistons alternate, the valves actuated by one admitting pressure to the other. At end of each motion, the pistons are brought to rest by adjustable buffers which determine the length of the stroke. One of the pistons is constantly in motion, giving uniform flow of water, free from pulsation or shock. The meters are perfectly noiseless in their performance. These test meters are designed and constructed of materials uniformly affected by expansion and contraction from varying of temperatures, thus further assuring their accuracy as measuring devices.



For an ordinary test, one of these meters was calibrated. By deducting the weight of water, as found by the meter registration from the actual tank weight, the figures showed the meter to be correct to within one-fifth of one per cent. To obtain correct results, these tests meters should be properly applied for operation, the size selected should be ample for the service, insuring ... and pipe connection should be made so that at ... the meter can be cut out for examination or repair without shutting down the boiler.

The accompanying cut shows the plan and elevation of a test meter, by Henry R. Worthington, New York.

A and B are three-way cocks to pass water through the meter and to the boiler, or, for calibration, to allow water to pass by the angle valve "E" to a tank placed on scales for weighing. By this arrangement it is possible to test the meter as frequently as desired. By setting the cocks "A" and "B," and breaking the couplings, "F" and "C," the meter may be removed without interrupting the operation of the boiler plant in any way. "C" is a gauge for indicating pressure; "D" is a thermometer for indicating the temperature of the water; "H" and "J" are pipe couplings. These connections should all be made of brass.

MACHINE SHOP NOTES FROM THE UNITED STATES.

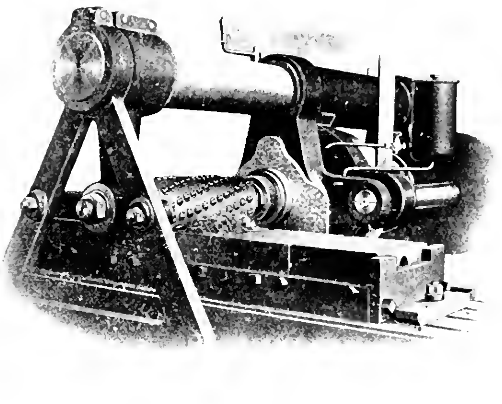
BY CHAS. S. GINGRICH, M.E.

The writer had an opportunity recently to visit some of the large machine shops in the States and found some very interesting things in the manner in which the work was being done and the rate at which they were doing it. One of the greatest surprises was the milling machine.

The great volume of business that has been coming to machine shops, during the past few years, has been the means of bringing about a more thorough investigation of cost reducing methods than has ever taken place heretofore, and has resulted in the re-designing of machine tools. Space does not permit of going into the details of all the new tools, and we will confine ourselves to the milling machines which we saw and which are doing work in about one-half the time formerly required to do the same work on shapers and small planers. Among the improvements that were made, the most noticeable was the method of driving the feed. The feed belt and feed cones have been superseded by mechanisms which transmit power from the spindle to the table of the machine entirely through gearing. The result is, that there is absolutely no slippage between the spindle and the table of the machine, and instead of limiting the rate of feed to suit the efficiency of the feed belt, these machines are now worked up to the limit of the main driving belt. The result is, that heavier and faster cuts are being taken than were before dreamed possible.

An illustration is here given of one of the Cincinnati Milling Machine Co.'s machines in operation, surfacing cast iron pieces $8\frac{1}{4}$ in wide. In manufacturing these pieces it is necessary to take a first roughing cut, and then a finishing cut; whether the work is done on a planer or a miller; and it is, therefore, considered good practice to take the roughing cut by the fastest means possible. It is this roughing cut that is shown in the illustration. The cutter is $4\frac{1}{2}$-in. in diameter, and is of the inserted tooth variety. It takes a cut about $\frac{1}{8}$-inch deep so as to get under the scale, and this work, $8\frac{1}{4}$-in wide, is actually fed past the cutter at the rate of $8\frac{1}{8}$ in. per minute. It might be also of interest to note here that the teeth of the cutter are made of ordinary carbon steel. The writer has data in hand of a similar piece of work having been done on this machine with a cutter having teeth made of "Novo" steel, in which case the rate of feed was $10\frac{1}{2}$-in. per minute. The pieces were finished on this same machine, feeding about $1\frac{1}{2}$-in. per minute, and producing a highly finished surface. We had the privilege of seeing the pieces after the roughing cut had been taken, and were surprised to note that although they were done at the remarkable rate above mentioned, the surface was one

that would be admirably adapted for brackets, pedestals, bearing caps, and similar work requiring an even surface, but not a high grade of finish.



Evidently a large amount of work that engine builders and general machinists are now planing or shaping can be done on a miller at the above rate.

MARINE NEWS.

It is proposed to erect a big coal dock at Port Arthur, Ont.

A large steel floating dry dock is to be erected at St. Johns, Newfoundland.

A new steamer is being built at Sturgeon Falls, Ont., by Captain Gridley for Cockburn & Sons.

Reid & Co. are building an extension to their machine shops at the dry dock, St. Johns, Newfoundland.

It is understood the Star Line Steamship Company, St. John, N.B., are seeking a new boat to take the place of the David Weston, recently burnt.

The Collingwood Bulletin states that E. J. Davis, of Toronto, and Captain F. X. Lafrance intend putting a fast boat on the Owen Sound and Sault Ste. Marie route.

The Hudson's Bay Company have in contemplation the building of an up-to-date, commodious steamer to ply between Prince Albert and points on the Upper Saskatchewan.

The Western Lakes Transportation Co. are contemplating the building or purchasing of another steel steamer for the lake freight trade between Fort William, Goderich and Collingwood.

P. P. Young will build a new excursion boat for the Kawartha Lakes at a cost of $11,000. Length, 96 feet; beam, 18 feet. The hull and machinery will be constructed by Bertrams, Toronto.

Tenders for a new dry dock will be received up to February 3, 1904, by the Imperial Dry Dock Company, 3 Water Street, St. John, N.B. Plans and specifications can be seen at the office of the company.

The J. T. Hutchinson, with a cargo of flax valued at $190,000, which got on the rocks on November 30 at Keweenaw Point, Lake Superior, and was feared would become a total loss, has been floated.

G. A. Tomlinson, Duluth, has ordered from the American Shipbuilding Company a boat 404 feet long, 52 feet beam and 29 feet deep. The vessel will be the largest freight carrier on the lakes and will cost $350,000.

The new battleships Libertad and Constitution have been sold by the Chilian Government to the British Government for nine million dollars. The Libertad is the fastest battleship afloat, having a speed of 20.3 knots per hour.

A new wrecking steamer, built by J. McGill, for the Provincial Wrecking Co., of Cape Sable Island, was recently launched at Shelburne, N.S., and is being fitted with powerful engines by the New Barrel Johnson Iron Co.

A tug 80 feet long for the Sincennes-McNaughton Co., Montreal, has been launched at Sorel, Que. She will have fore-and-aft compound engines, cylinders 18 and 36 in. by 24 in. stroke, and Fitzgibbon marine boilers carrying 150 lbs. of steam.

The largest full-rigged ship afloat recently arrived at St. John, N.B., to load lumber for Australia for Cushing & Co. She is the Lansing, and was originally a steamship. Her dimensions are: Length, 405 feet; beam, 48 feet; depth, 23 feet; net tonnage, 2,605.

Capt. Coates, of Fort Frances, Ont., together with several business associates, will engage in steamboating on the Saskatchewan river next year. The first boat, a stern wheeler, is to be constructed this winter. Length, 150 feet; beam, 28.

The breakwater at Port Colborne has been completed. The structure cost $515,000. It is built of timber, covered with concrete, is 4,400 feet long and 50 feet wide. It has a head block of 60 feet in width, upon which a lighthouse of steel and concrete has been erected.

A company is being formed in London, Eng., to build a fleet of twelve specially designed vessels for grain carrying between the Great Lakes and Montreal. Capital, $1,500,000. The directors are J. Torrance, R. Bickerdike and A. Racine, of Montreal; C. Carpenter and Jos. Mellows, of London, Eng.

The Quebec Steamship Company has placed a contract with Sir James Laing & Son, of Sunderland, for a 5,000 ton, 16 knot, twin screw steel steamer, 425 feet long, 50 feet beam, and 36 feet 6 inches deep, with accommodation for 240 saloon, 32 second class and 48 third class passengers. The vessel will have large cold storage capacity, and is to be delivered on November 1, 1904.

The preliminary work of widening the United States ship canal above the Government locks at the Soo has been started. A coffer-dam is to be constructed. At present the canal is too narrow to accommodate traffic, and the improvement will do away with much of the swift current which has troubled the vessels. The filling work will take nearly two years to complete.

J. A. Cuttle, general manager of the Montreal Transportation Company, considers that the best course for the future development of the trade of the Great Lakes, from a Canadian standpoint, is to deepen the Welland Canal to eighteen feet. This would allow the Great Lake freighters to come to Kingston and Prescott, from where grain could be carried in barges, and shipped by ocean-going vessels from Montreal.

A successful trial of the Doenvig life-saving globes has been made at Skaw, on the dangerous North Jutland coast. During a storm the inventor, with four other persons, were launched from the cruiser Heimdal in a globe, which cleared the breakwaters and shoals and drifted safely ashore.. The apparatus is made of light steel plates, surrounded by a cork fender. It has a flat, double bottom, containing tanks, which can be filled with fresh water and used as ballast. There are also compartments for stores. The sphere can comfortably hold sixteen persons.

Extensive additions will be made to the Government docking facilities at the Canadian Soo. The present dock is to be extended 300 feet out into the river, and built in an "L" shape, so that there will be 300 feet of frontage, with 22 feet of water, and a landing frontage along the east side of 700 feet, 22 feet deep at the outer corner, and varying to 12 feet towards the shore. Three hundred feet on the west side will be available for use by tugs and smaller boats. The work will cost $30,000, and will be rushed all winter. Geo. A. Boyd, who has charge of the work, expects to have it completed by the spring. A warehouse, 70 x 250 feet, will also be added to those already in use.

The Minister of Marine, accompanied by the Deputy Minister, Hugh A. Allan and Andrew Allan, has inspected a system of electrical submarine signals which may be introduced on the St. Lawrence. By this system signals can be made between vessels a distance from each other, and between vessels and lighthouses. The tests were made from the steamer H. M. Whitney, which had been specially equipped for the purpose. The best demonstration was off the Boston lightship. When seven miles away from this lightship signals could be distinctly heard, though the vessel from which it came

was hull down. Another demonstration was given, when those on board the Whitney were notified of the proximity of a sister ship on her way from Boston to New York by the ringing of the bell, although some miles distant.

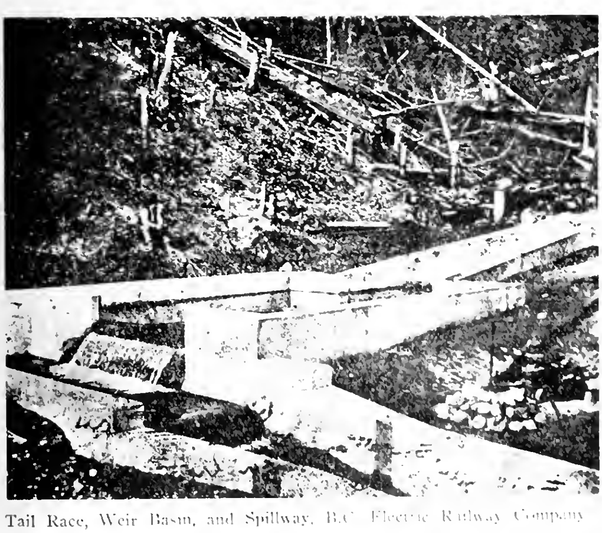
A novel vessel for the United States navy was launched recently from the yards of the Gas Engine and Power Company, and Charles L. Seabury & Co., Consolidated, at Morris Heights. Length, 80 feet; beam, 18 feet, and draught, 3 feet 6 inches. When loaded she will displace 72 tons. It is for use on transports, and is built in five sections, each watertight and box-like in form. The plating of all is ¼-inch ship steel, with lap points. In putting the vessel into commission, the boiler section will be floated first, establishing the water line, and the others will follow in order, working either fore or aft. They are fitted with sea valves, and sea water is admitted into their bottoms until they reach the common water line. When the sections have been fastened together the water ballast will be removed, and the boat will be ready for service.

The two new vessels being built for the fisheries protection service will be cruisers, for their size equal to anything in the British navy. Their speed will be seventeen and sixteen knots respectively. The largest vessel is for the Atlantic coast service, and will be built by the Vickers-Maxim Company. She will be a twin-screw steamer of 700 tons, 200 feet long and 25 foot beam, and will carry sixty bluejackets. She will have armoured decks and a searchlight of 4,000 candle power. Her armament will consist of several pom-poms and Maxim-Nordenfelt quick-firing guns. The second cruiser will be built by the Polson Iron Works, Toronto. She will also be a twin-screw, 176 feet long, 22 feet beam and 540 tons. Her crew will number 45 men and her armament will be pom-poms and Nordenfelts. She will outvie in speed and armament anything on the Great Lakes. These cruisers are to be ready in six months, and they will have the unique distinction of being the first two vessels of the Canadian navy.

GOLDSTREAM-VICTORIA WATER POWER AND ELECTRICAL TRANSMISSION.

BY E. JACOBS, IN THE B.C. MINING RECORD.

The British Columbia Electric Railway Company operates its system in Victoria by electricity generated by water power obtained from the head of Goldstream where, at a distance of 17 miles from the city, there are three lakes.



Tail Race, Weir Basin, and Spillway, B.C. Electric Railway Company

The Esquimalt Water-works Company, which holds the water right, some years ago built substantial dams for water storage purposes. From these dams the water flows along the bed of Goldstream two and a half miles to the balancing reservoir, which has a capacity of 22,000,000 gallons and is at an altitude of 655 feet above the [illegible] power house. The supply pipe-line, which is 7,9[illegible] in length, is of rivetted sheet steel, and for the first part of its length is 33 inches in diameter, afterwards being 3[illegible] water is delivered at the generating station at a pressure of 285 lbs. per square inch.

The power house is a fire-proof structure [illegible] of brick and concrete and roof of tar and gravel. Its dimensions are, length, 56 feet; width, 42 feet, and height, 24 feet, and it is sub-divided into three compartments, viz., a water wheel room, a generator room and a transformer room. The plant installed in it consists of two 38-inch Pelton iron-mounted type impulse water wheels, each developing 600-h.p., and one 54-inch fitted with Dodd buckets and developing 900-h.p. Lombard automatic hydraulic governors are used in connection with all these wheels. The speed of the large wheel is controlled by a needle valve and deflecting nozzle, that of one of the smaller wheels by a deflecting hood, and that of the other by a cut-off hood.

The water-wheels are direct-connected to Canadian machines, and the larger to a 500-kilowatt revolving field alternator. The 12½ kilowatt exciters for the General Electric 60-cycle three-phase generators, the two smaller to two 360-kilowatt rotating-armature smaller generators are belt-driven, whilst a 20-kilowatt exciter is direct-connected to the larger generator. The capacity of each exciter is sufficient to admit of its operating the whole plant and the switching arrangements are such as to provide for its doing so in case of need. The current, after being generated at 700 volts' pressure, is led to a switchboard having five marble panels—three for the generators, one synchronizing, and one total output—and thence to three sets of step-up transformers, which raise the voltage to 17,300 volts, at which pressure it is delivered to the transmission lines. The high-pressure side of these transformers is connected with the neutral point grounded at the generating station only. An air blast is supplied to the transformers by two Buffalo blowers, one 50-inch and one 80-inch, driven by direct current motors of 4-h.p. and 8-h.p., respectively.

The transmission line is thirteen miles in length. It consists of two three-phase circuits of No. 4 B. & S. copper wires mounted on 22,000-volt insulators. Both are strung on the same pole line. For the first mile the line passes through a rough timbered country to the Esquimalt and Nanaimo Railway, along the right of way of which it runs eight miles, and thence four miles to Victoria. Owing to there being many high trees along the route of the line, the right of way has been cleared, where necessary, to a width of 600 feet, to guard against interruptions to the service from falling trees. The difference in elevation between the generating station and the city is about 475 feet.

The sub-station in Victoria is a commodious brick building, formerly the power house when steam was used for generating the electric current. The steam power plant, consisting of six [illegible] tubular boilers, a cross-compound [illegible] engine and a high-speed Ball automatic engine, together with an electric equipment including alternating generators with a total capacity of 400 kilowatts, for lighting, and 300-kilowatt 500 volt direct current machines, for railway purposes, switchboard and other requisite electrical appliances is kept here in reserve in case of accident to the water power. The conductors are led into the sub-station from the front of the building through 12-inch glazed tile pipes, set at an angle of forty-five degrees as a protection against bad weather. They are taken thence [illegible] a separate wire well to lightning arresters and [illegible] situate in the basement, where there are [illegible] switches so arranged that any set of transformers may be

connected to either of the two transmission lines. There are six 125-kilowatt transformers which lower the pressure from that at which it is received to 1,040 volts, for lighting purposes; also six 125-kilowatt transformers reducing the voltage to 350 volts, the secondaries of these being led to two three-phase, 300-kilowatt, 60-cycle, rotary converters, these supplying the direct current for the electric railways and for other purposes, there being about 100 motors of various sizes in use in the city.

In connection with its lighting system, the company has some 40,000 incandescent, 200 Nernst, and 50 commercial arc lamps. In Victoria, the company's patronage is chiefly for commercial and residential lighting, the corporation of Victoria having its own electric street lighting system. The local electric railway system comprises some fifteen miles of track, including the lines from the city to Esquimalt. The British Columbia Electric Company, Limited, is an English organization, with head office in London. Its operations cover electric railways and lighting in Vancouver, as well as Victoria, and railways in and to New Westminster and Vancouver. The Vancouver branch of the company's enterprise is by far the most important. The chief officers of the company, at Vancouver, are: J. Buntzen, general manager; R. H. Sperling, general supt.; W. F. Gitchell, comptroller; B. W. Slocum, chief engineer, and J. B. Rannie, superintendent of traffic, at Victoria; A. T. Goward, local manager; G. M. Tripp, superintendent.

ISOLATED SEWAGE DISPOSAL PLANT.*

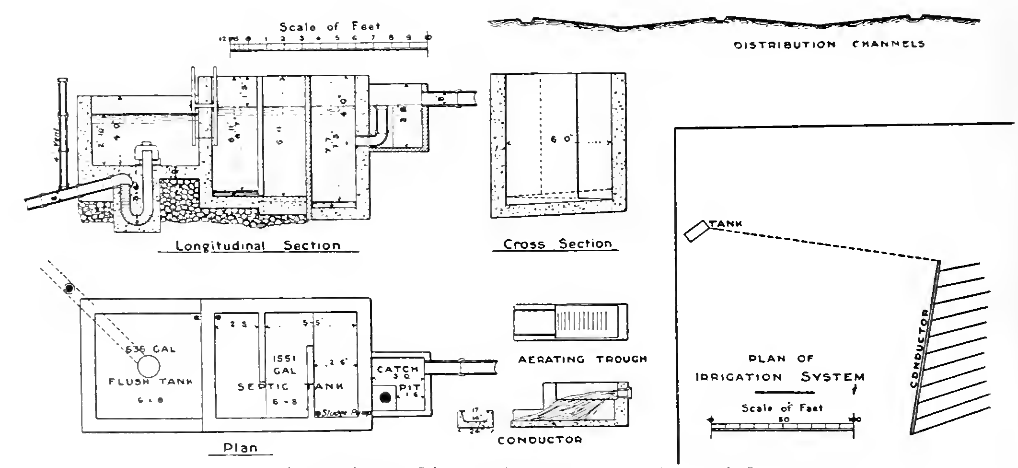
In October, 1901, the author received instructions to design and construct a sewage disposal system for the Provincial Gaol at Victoria. It was found that to connect with the city sewerage system would involve a large expenditure, and it was finally determined to dispose of the sewage on the gaol property of about twelve acres. An examination of the existing work showed it to be in a most offensive and dangerous condition. This discharge was into an untrapped brick cesspool, the overflow from which ran into a field. Near the cesspool the ground was excrement sodden; and the odor three or four hundred feet away was something phenomenal when waited on a favoring breeze. The pipes, of six-inch diameter, from the gaol had been laid regardless of grade and direction, and a very considerable percentage of them were broken. Under the circumstances, the prevalence of disease was not surprising.

The daily flow of sewage varied from 1,200 to 1,800 gallons a day, which it was supposed to dispose of by surface irrigation. The soil was not an ideal one for such purpose, as it consisted of a stiff clay fit for brickmaking, with practically no loam on the surface, and it was with fear and trembling that surface irrigation was resorted to. Had that failed, double contact beds would have been the next method adopted. In the first place, the cesspool and old pipes were entirely abandoned. New eight-inch pipes, properly jointed, and laid true to grade and alignment, connected the buildings with a catch pit, about 250 feet distant. From the catch pit the sewage flowed into a septic tank of 1,550 gallons' capacity, the effluent from which passed into a 636 gallon flush tank, discharging about twice a day. The contents of the tank, after passing through an aerating trough, charged a concrete conductor, from which the distribution channels on the surface of the ground were fed.

The catch pit is of brick in cement, three feet square, and is fed by an 8-inch sewer from the gaol. Its effluent discharges into the septic tank, at 2 feet 3 inches below water level, through a six-inch trapped pipe set in concrete in one corner. The catch pit might perhaps have been dispensed with, but, bearing in mind the mischievous proclivities of prisoners, and the strong probability that all sorts of foreign substances would be wantonly thrown down the closets, it was considered advisable to construct one, and its adoption has been amply justified by results. The pit is cleaned out at short intervals, and its miscellaneous contents buried.

The septic tank is built of five parts of sea shingle and sand to one part of White's Portland cement. It is 6 ft. by 8 ft. inside, with nine-inch walls, and is smoothly cemented. The floor has a fall of 1 in 18 towards the inlet. There are two half brick baffle walls to prevent any direct current between the inlet and outlet, and also to increase the length of channel, and afford better opportunity for the deposition of the matters in suspension. This plan appears to the author to combine the advantages of the usual long narrow tank with economy. The outlet is of two-inch wrought iron pipe, H shaped, with an entering limb 2 feet 3 inches below the horizontal discharge, the end of which in the flush tank is tapped, and, as the ends are open, no syphonage can occur, and any obstruction is easily removed.

The flush tank is 6 feet square, and discharges when a depth of 2 feet 10 inches is attained. The syphon is a six-inch Miller, discharging through a six-inch sewer pipe into the aerating trough. In the drawing it is shown when about to discharge.



Plan Sewage Disposal, Provincial Gaol, Victoria, B.C

The trough is a box of No. 26 galvanized iron, provided with slits in the bottom and end, set 15 inches above the conductor, and fed by the 6-inch pipe before mentioned.

The conductor is a level concrete trough, of which a cross section is shown on the drawing, and has ample capacity for one discharge of the flush tank. It is provided with eleven tapering outlets, furnished with stops so as to divert

*From a paper by E. M[illegible], C.E., read before the Can. Soc. of Civil Engineers.

the flow to such distribution channels as require irrigation. The tanks and catch pits are provided with plank covers.

Owing to some misapprehension, the channels were not placed, as shown in the drawing, but small gutters were cut below the general surface of the ground. It is, however, intended to carry out the original plan this year after the removal of the crops. Before the sewage was turned upon the land, about a quarter of an acre was thoroughly dug, and the sewage has generally been applied to this area, though occasionally diverted to an adjacent piece under cultivation.

The sewage was first turned into the tank on the 20th December, 1901. All the sewer gas has been completely cut off between the catch pit and the gaol, and there is a marked improvement in the sanitary condition of the building. The surface scum in the septic tank was of very slow growth; indeed, the tank was working fully six months before a complete coating was formed. During that period the effluent was very turbid and somewhat offensive. Since then there has been a marked improvement. Though not absolutely clear, it is inoffensive, except when confined for some hours in the conductor. The surface in the septic tank in May, 1903, was completely covered with a coating about two feet thick from which no offensive odors arise. On the 18th May, 1903, a sludge pump was placed in position in case there should prove to be a considerable amount of sludge deposited during the eighteen months' work of the tank. In that period from 650,000 to 800,000 gallons of sewage must have passed through the tank. The pump has a 2½-inch suction, reaching 8½-in. above the bottom of the tank. On starting it, no sludge deposit was found at that depth, the discharge being precisely similar to that of the catch pit. The pump was placed in position, so that, in the event of the tank area available for liquid sewage becoming restricted, it would always be possible to remove a few yards of sludge without disturbing the surface scum, and with the least possible trouble and annoyance.

The character of the soil, which, as before stated, was an unproductive clay, appears to be much improved. Sweet corn, peas, cabbages, beets, carrots and leeks have been raised of excellent quality, and it appears not improbable in the future that the value of the crop might equal the interest and sinking fund for the original outlay. The cost of the whole plant—common labor being furnished by the prisoners—has been as follows, and includes tearing up and replacing the old sewers and trenching, about 150 feet of which was in rock:

Lumber and haulage	$ 50 78
Cement (32 barrels at $3.50)	112 00
Haulage of cement, shingle and sand	52 55
Syphon and freight	37 50
Sewer pipes	138 80
Aerating trough	12 45
Labor and superintendence	164 75
Sludge pump	21 00
	$589 83

MONTREAL, THE GREAT ELECTRIC POWER CITY.

BY ALTON D. ADAMS, IN THE "ELECTRICAL WORLD AND ENGINEER."

Montreal consumes more electrically-transmitted water power than any other city in the world. This power is drawn from three generating stations located on the rivers St. Lawrence, Richelieu and St. Maurice, at distances that range up to eighty-five miles from the central sub-station in the city. With the vast drainage area of the Great Lakes, the Champlain Basin between the Green and Adirondack Mountains to gather water for the Richelieu, and a great stretch of northern Canada to supply the St. Maurice river, the reliability of electrical supply from water power is assured in Montreal. At Chambly power house, on the Richelieu river, seventeen miles by the transmission line from Montreal, the combined capacity of the main electric generators is 16,800-K.W. The Lachine power house, on the St. Lawrence, five miles from the city, contains generators of 6,000-K.W. total capacity. Both of these power plants are devoted exclusively to the operation of the Montreal system. Neglecting the total equipment of the great power house at Shawinigan Falls, on the St. Maurice river, which is operating under a head of 145 feet, and in which the turbines, of 6,000-h.p. each, are installed, with generators of 3,750-K.W., the energy being transmitted 85 miles to a sub-station in the suburbs of Montreal, the transformer capacity of which is 5,000-K.W., requiring about 6,000-K.W. in generator capacity at the Shawinigan plant. The total rating of the present generators in water-power stations, supplying Montreal, is thus 28,800-K.W. This capacity will shortly be increased in two directions. A fifty-year contract requires the Shawinigan Company to deliver up to 20,000 h.p., and another water power is about to be developed at Soulanges on the St. Lawrence, for the city system.

In anticipation of this increase of capacity, the sub-stations in Montreal have been equipped beyond immediate requirements. Besides that of the Shawinigan system, already mentioned, there are two sub-stations in Montreal devoted to general electrical supply. At one of these, known as the McCord Street sub-station, the total transformer capacity receiving the high-tension transmitted energy is 7,000-K.W. In the main or central sub-station, the total capacity of transformers connected to the transmission lines is now 27,500-K.W. with room for an increase. Including the 5,000-K.W. at the Shawinigan sub-station, 4,750-K.W. of which is entirely devoted to the Montreal system, the combined capacity of stepdown transformers is thus 39,500-K.W. or 52,000-h.p. It is safe to say that no other city in the world has an equal capacity of stepdown transformers delivering energy from water powers to an electrical supply system.

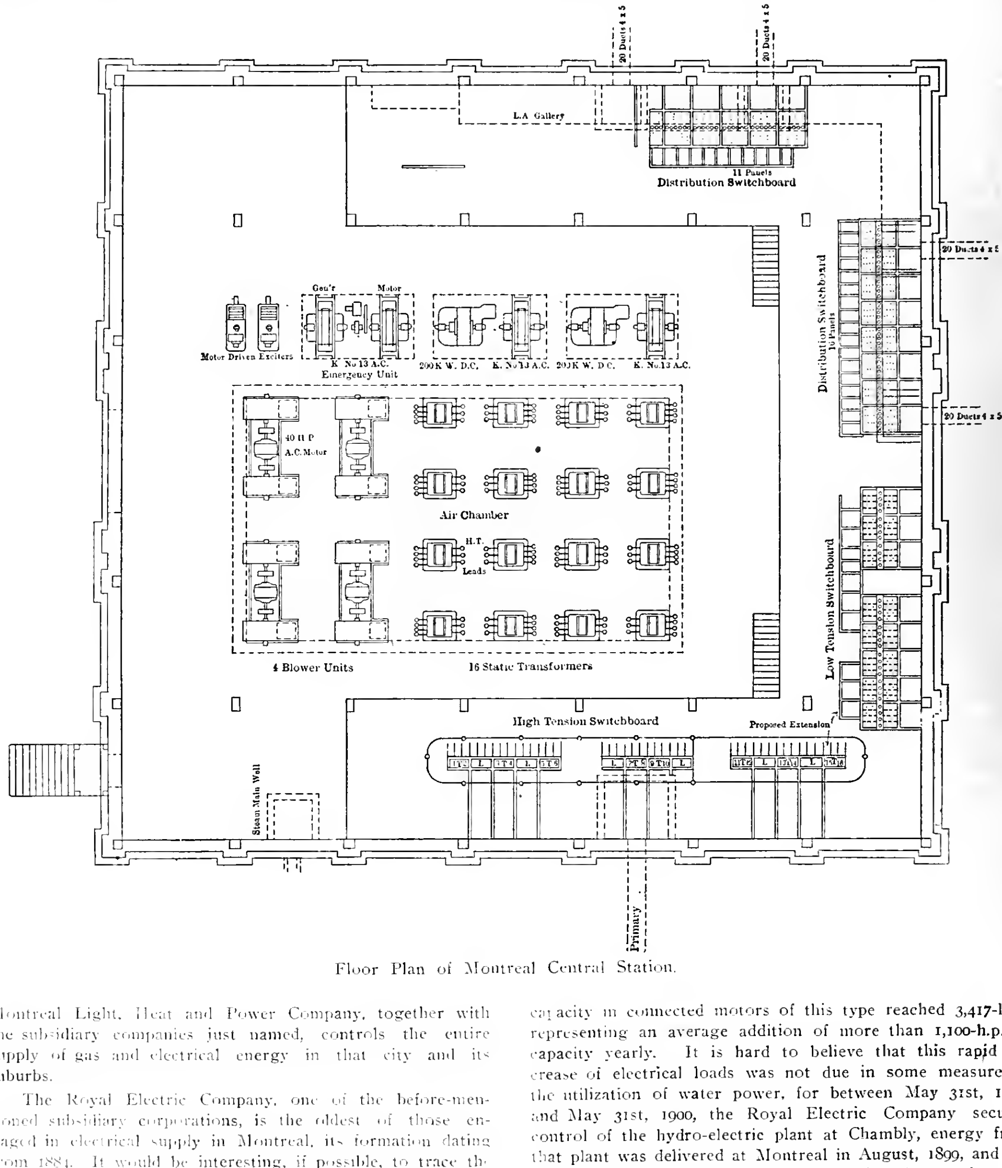
Besides these water power plants and sub-stations, the system includes steam power stations at five points, with a combined capacity of 5,700-K.W. These plants are in large part a legacy of former conditions, and are held as a reserve for the water power system. The largest of these steam driven stations is on Queen street, has a capacity of 2,400-K.W., and has been remodelled during the past year.

Electric light and power supply is distributed by the Montreal system for a distance of about fourteen miles along the river front, and to an average width of between three and four miles from its bank. Included in the service area is a strip of territory about one mile wide and four miles long on the mainland opposite to the city. Within this area there are 11,152 customers using commercial arc and incandescent lamps, and 870 customers using motors, besides the cities and towns that are supplied with street lamps. The municipalities, whose streets are lighted, number fifteen, including Montreal, and all except two of these are on the island. The total connected load of street lamps numbers 1,717 arc, and 577 incandescent; 11,152 customers take current for 290,903 incandescent lamps, 1,514 arc lamps and 405 pieces of various apparatus, such as fans and heaters. 870 consumers use power for 1,109 electric motors with an aggregate capacity of 19,172-h.p. These figures show that the utilization of water powers has made the operation of motors an important part of the business of Montreal; 2,101 service transformers with an aggregate capacity of 13,240-K.W. are employed for the private lighting and part of the public incandescent street lamps. For the motor load 605 transformers with a total capacity of 6,980-K.W. are employed, but these do not operate all of the connected motors, many being of the direct-current type, and many of the alternating motors operating at the full voltage of distribution.

This system, which constitutes the only public supply of light and power in Montreal, has been welded together out of diverse elements. The Montreal Light, Heat and Power Company, the owner of the system, was incorporated in March, 1901, for the purpose of consolidating all the gas and electric companies doing business in the city. In conformity with this purpose, it is authorized by its charter to acquire plants for the supply of gas, electricity or other source of light, heat or power. The company may also lease and operate all or any part of the plants of any other company engaged in the supply of light, heat and power, and

may acquire and hold the stocks and bonds of any such corporation. When this company has acquired the plant of any other company, it may exercise the charter rights and franchises of such other company. The company has also the right to construct lines under or over the public streets of any place within one hundred miles of Montreal in any direction.

Pursuant to these liberal and important powers, the Montreal Light, Heat and Power Company acquired a majority of the stock of each of the following companies: The Montreal Gas Company, the Royal Electric Company, the Montreal and St. Lawrence Light and Power Company, the Imperial Electric Light Company, Limited, the Lachine Rapids Hydraulic and Land Co., Limited, the Standard Light and Power Company, the Citizens' Light and Power Company, Limited, and the Temple Electric Company. The companies. Direct-current arc lamps connected to the circuits of the Royal Electric Company numbered 1,287 in the year 1890; 1,666 in 1895, and 1,859 in 1900, showing an increase of 44 per cent. during the ten years. During the same period the load of arc and incandescent lamps on the alternating-current circuits rose from an equivalent of 1,835 incandescent lamps of 16-c.p. each to an equivalent of 93,-498. In other words, the load of arc and incandescent lamps on alternating circuits was 59 times as great in 1900 as it was in 1890. Direct-current motors first appeared on the circuits of the company in 1892, when their total rating was only 50-h.p., but by 19 0 this capacity had risen to 1,253-h.p., or twenty-five times the rating in the earlier year. The latest factor in the electric load was the alternating-current motor, which did not appear in the returns until 1897, and was then credited with a combined rating up to 18-h.p. In 1900, the



Floor Plan of Montreal Central Station.

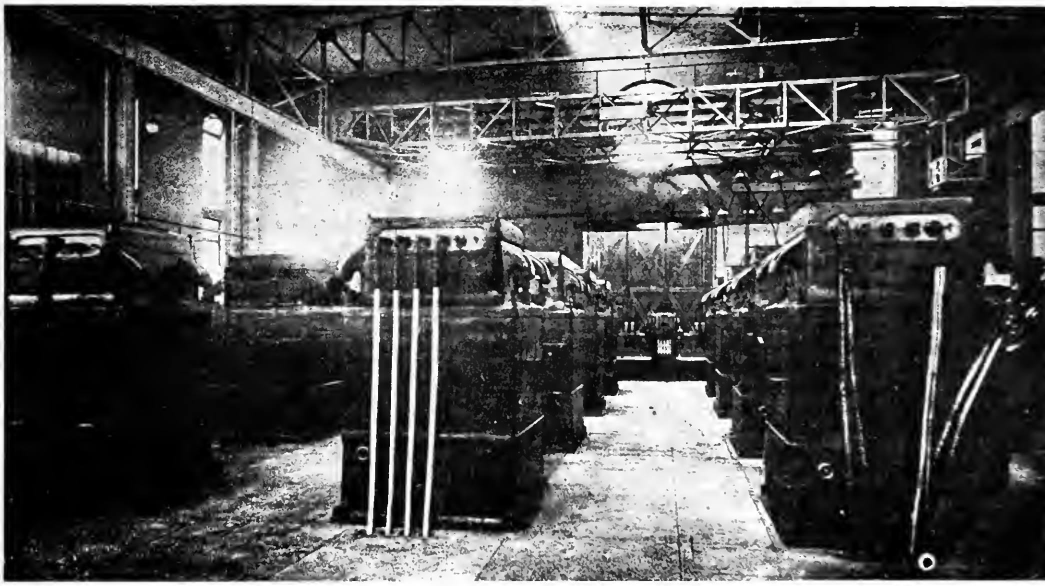
Montreal Light, Heat and Power Company, together with the subsidiary companies just named, controls the entire supply of gas and electrical energy in that city and its suburbs.

The Royal Electric Company, one of the before-mentioned subsidiary corporations, is the oldest of those engaged in electrical supply in Montreal, its formation dating from 1884. It would be interesting, if possible, to trace the increase of electric loads among all the companies at Montreal during the past years, but the facts are not at hand for any of these companies save the Royal Electric. Figures for the loads of this company are, however, no doubt more representative and larger than figures for any of the other capacity in connected motors of this type reached 3,417-h.p., representing an average addition of more than 1,100-h.p. in capacity yearly. It is hard to believe that this rapid increase of electrical loads was not due in some measure to the utilization of water power, for between May 31st, 1899, and May 31st, 1900, the Royal Electric Company secured control of the hydro-electric plant at Chambly, energy from that plant was delivered at Montreal in August, 1899, and the rise of electric loads was more rapid during the year between the two dates just named than in any other of the decade. Thus, during the twelve months that ended May 31st, 1900, the increase of the Royal system of the equivalent load of 16-c.p. incandescent lamps was 14,460, and the rise of capacity

in connected motors was 116-h.p. for those of the direct-current, and 2,176-h.p. for those of the alternating type. To water power must also be traced the strong tendency to consolidation that culminated in 1901.

Electrical supply in Montreal and its suburbs is distributed from three sub-stations, the central, the McCord street, and the Shawinigan sub-station respectively. The central sub-station is nearest to the business centre of the city, the McCord street sub-station is about one-half mile to the west, and the Shawinigan sub-station is approximately three and five-eighth miles to the east. At each of these sub-stations the energy transmitted from the water power plants is transformed or transformed and converted to alternating current at 2,400 volts, 63 cycles per second, and either two or three-phase. At the central sub-station a portion of this 2,400-volt alternating current is transformed to 4,000-volt constant current for the series arc lamps and another portion of the 2,400-volt current is transformed and converted to direct current at 250 volts for a three-wire system of 500 volts between outside wires, that carries a part of the motor load. All three of the sub-stations are tied together by the 2,400-volt feeders, so that the energy received from either water power plant may be delivered to consumers on any part of the distribution system. Constant, direct current is supplied for a part of the series street lamps by means of motor-driven arc dynamos.

an aggregate capacity of 16,[illegible]-h.p. g[illegible] [illegible] capacity of 28.4-h.p. each, average being 1.3[illegible] [illegible] per customer. This large average horse-power [illegible] and per customer, shows the extensive use [illegible] a[illegible] motors in manufacturing operations. Some of the alternating motors are of the synchronous, but the greater [illegible]ber is of the induction type, and all are supplied with [illegible]rent of 63 cycles and either two or three-phase. M[illegible] these motors are operated from the 2,400-volt cir[illegible] through transformers at a voltage of about 550; but som[illegible] the large sizes receive the full line voltage in their wind[illegible] 529 direct-current motors are in use by 444 customers, [illegible] have an aggregate capacity of 2,616-h.p., the average capa[illegible] being almost 5-h.p. each, and the average per customer [illegible] motors and 6-h.p. The average power per customer, and per motor, is nearly six times as great for the alternating as for the direct-current type, thereby showing that the alternating type of motor is more generally applied for large powers. The two largest customers, the Montreal Street Railway Company and the Dominion Cotton Mills Company, use 21 motors of the alternating type of an aggregate capacity of 8,005-h.p., besides some smaller sizes. If these motors and their total capacity are deducted from the total figures for all motors of the alternating type, the result shows a balance of 559 with a combined rating of 8,551-h.p. These last figures correspond to an average capacity of 15.3-h.p. per



Transformers, Central Station, Montreal Heat, Light and Power Company

Of the arc street lamps, 1,333 are enclosed series alternating, and 384 lamps series open direct-current; all of 2,000-c.p. each. The enclosed alternating arcs operate nominally on 80 volts and 7.5 amp. each, or 480 actual watts. On the direct-current arc lines the rating is 9.6 amp.

Of the 577 incandescent street lamps, 100, 65-c.p., and 273, 32-c.p., are on the constant alternating-current lines, 37, 32-c.p., are on direct current circuits, 50, 32-c.p., are in multiple on the 220-volt system, and 91, 32-c.p. and 18, 16-c.p. each are in the multiple at 110 volts. As a proportion of the 299,903 incandescent lamps in commercial service are below 16-c.p., the average candle power would be less than 16 per lamp. The constant-potential commercial arc lamps number 1,277 on alternating circuits. Commercial service also includes 23 constant-current, enclosed alternating arcs and 214 direct-current series open arc lamps.

Most notable in this system is the load of stationary motors, because of their large number, great aggregate capacity and the unusual average capacity of each. 580 motors in use by 426 customers are of the alternating type and have

motor, or 2.5 that of the like average for all of the direct current motors. This again brings out the fact that the alternating motors have been more generally selected for large amounts of power.

The Montreal Street Railway Company has a larger capacity in motors connected to the system than any other users. This capacity amounts to a total of 4,015-h.p. and is made up by seven 2,200-volt, two-phase motors that operate with alternating current of 63 cycles per second. Six of these motors are of the induction type and rated at 550-h.p. each, while the seventh is a synchronous motor of 715-h.p. For the supply of energy to these motors, seven two-[illegible] circuits are run from the central sub-station to the generating station of the Street Railway Company. These motors are believed to be among the largest of this type in use anywhere. It is believed that they require less skill in their operation, and cause less fluctuation of voltage in the electric supply system than synchronous motors of equal capacity. On the other hand, one disadvantage of induction motors, that of a very short air gap between the rotating

and stationary parts, is here illustrated. Thus, in these motors of 700-h.p. each, the air-gap for each of two is said to be only 3-32-in., and the air-gap for each of four only 0,0285 in. from iron to iron. Each of these motors is direct-connected to a continuous-current generator that supplies the street railway system at about 550 volts.

The plant of the Dominion Cotton Mills Company is probably one of the largest of its kind that draws its power from a public system of electrical supply. In these cotton mills the total number of electric motors is 27, and their combined rating amounts to 3,412-h.p., divided as follows: Number of motors, 5 of 300-h.p. each, 1 of 240-h.p., 5 of 200-h.p., 1 of 150-h.p., 2 of 100-h.p., 2 of 75-h.p., 1 of 50-h.p., 1 of 30-h.p., 1 of 20-h.p., 2 of 15-h.p., 2 of 10-h.p., 1 of 7-h.p., 3 of 5-h.p. All of these motors in the cotton mills are of the induction type, save one of 200-h.p. capacity, which is synchronous. The fact that the Montreal electrical supply system is able to furnish power for this great manufacturing plant on terms that make it unprofitable for the latter to operate with steam is a striking illustration of the advantages of transmitted water power.

Of the transformers used for lighting, 1,068 are of less than 5-K.W. capacity each, 314 have an individual rating of just 5-K.W., and 779 transformers are rated at 7½ to 60-K.W. each, all having a combined rating of 13,249-K.W., and of this total those of less than 5-K.W. each represent 2,222½-K.W., of just 5-K.W. each, 1,570-K.W., and of more than 5-K.W. each an aggregate of 8,930-K.W. capacity. Of the transformers used for power service, 273 are rated at less than 5-K.W. each, 98 have just this individual capacity, and 324 are of larger sizes up to 170-K.W., and their combined rating of 6,980-K.W. used for power purposes is divided into 620-K.W. for those of less than 5-K.W. each, 490-K.W. for those of just 5-K.W. rating, and 5,867½-K.W. capacity in those of from 7½ to 170-K.W. each.

Comparing the lighting and the power transformers, the average rating of all the former is 6.1-K.W., and of all the latter 10.0. Of the aggregate rating of 3,249-K.W. for all lighting transformers, 67 per cent. is in units of more than 5-K.W. capacity each, while of the 6,980-K.W. of total capacity in power transformers, 85 per cent. is represented by those of more than 5-K.W. each. These figures bring out one desirable feature of a motor load, namely, that the transformers required for its operation are usually of larger average capacity and consequently of higher efficiency than those used for lighting. Large motors of 100 or more horsepower each have the further advantage that they may take current directly from the distribution lines, and thus require no service transformers whatever.

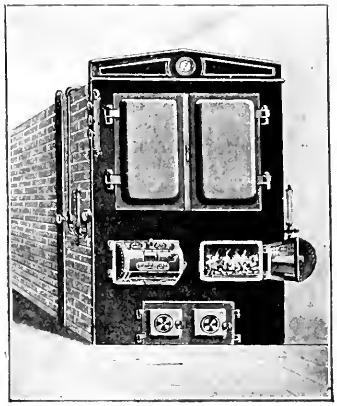
The Public Works Department, Ottawa, Ont., has advertised a sale of the electric lighting plant at the foot of Parliament Hill. The Government find that the light can be had more cheaply from the Ottawa Electric Company, and the equipment is now being sold out.

The Crowland Natural Gas Company has contracted to supply gas to the Niagara Falls Gas Light Company, and a main will be laid to Montrose bridge. The Clifton company is also pushing its pipe laying. It has leases in the Crowland field, but is laying a main from the Winger field, where it has developments.

"HYDRO-CARBON" SYSTEM OF COAL BURNING.

The Steam Boiler Equipment Co., of New York, have appointed P. E. Durst & Co., Yonge St. Arcade, Toronto, as their agents in Canada for the "hydro-carbon" system of coal burning. The claims made for this system, as stated in the company's literature, are as follows:

"The system is based upon natural laws and accomplishes its results in a simple manner, and its apparatus is easily equipped to any type of boiler for any steaming purpose, at a very moderate cost, without any change in the setting of the boiler or in the fire chamber or of the grate bars, and can be used or discontinued at any time without disturbing the fires. A specially designed patented door apparatus is substituted for the ordinary fire door, so arranged that the air is heated first and passed into the fire chamber over the fire, and by a peculiar arrangement distributed in proper proportions (suited to varying conditions of fuel used or requirements), to form an induced draft, supplying to the carbon from the coal the needed amount of free oxygen to change the conditions of the combustible gases from carbonic oxide to di-oxide and monoxide gases—thus obtaining from every pound of coal burned nearly double the amount of heat units, largely decreasing the temperature of escaping gases in the chimney, and leaving in the ash pit only the clay residuum of the coal. The carbon laden smoke from soft coal is prevented as the carbon is turned into combustible gases and heat units, in the fire chamber. In addition another element of heat is added to the coal, by superheating a small amount of steam in a heavy metal retort (of special design



and material to withstand the heat), and disassociating the steam, thereby forming hydrogen gas which is ejected into the fire chamber, in combination with the induced draft, thus forming a powerful adjunct and increasing largely the ratio of evaporation, owing to less frequent firing and use of slicing bars, less deposit of soot in or on tubes and shell, and less ash to remove; labor is saved, often dispensing with coal passers or giving the firemen more time for other duties. It is a well established fact that bituminous or soft coal will produce more heat units than anthracite or hard coal, and is therefore preferred for steam production, but in ordinary methods of burning soft coal so much objectionable smoke is produced by escape of free carbon, that it has been largely prohibited in the cities, and always is an exhibit of money and undeveloped power wasted in the atmosphere."

Among the points claimed for the system are: There is no disturbance of the fire box or change of grate bars in installing the apparatus; no building of fire walls or ducts or interference with steam pipes, nor are blowers required; the boilers are not altered and tubes do not require so frequent cleaning. This system has been installed in the new Flett-Lowndes Building, and the J. F. Brown Co.'s new building, in Toronto, and other installations are under way. Further information can be had from P. E. Durst & Co.

According to the Victoria, B.C., Times, it is not likely the Grand Trunk Pacific terminus will be located until next summer. The chief engineer of the company on the Pacific coast, Mr. Van Arsdol, says no decision has been reached as to a terminal point. He took parties to points along the northern coast a few months ago, and these are conducting a reconnaissance survey. They are spending a good deal of time on water, and the harbors are being examined from the standpoint of their suitability for water communication. It is announced that 250 miles of coast line is being examined, and it is, therefore, assured that the company will consider harbors at least as far south as Kitimaat. With the Yukon trade in view, the company may seek a point as far north as practicable. Some of the parties now in the field, it is said, are making a careful survey of the mouth of the Skeena.

The Canadian Engineer

Vol. XI.—No. 2. TORONTO AND MONTREAL, FEBRUARY, 1904. PRICE 10 CENTS $1.00 Per Year.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY; MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

Subscription—Canada, Great Britain and the United States, $1.00 per year, foreign, 6s. Advertising rates on application.

Offices—18 Court St. Toronto ; and Fraser Building, Montreal.
Toronto Telephone, Main 4310. Montreal Telephone, Main 2589.
BIGGAR-SAMUEL, Limited, Publishers,

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 15th of the preceding month or if proof is desired, 4 days earlier.

CONTENTS OF THIS NUMBER:

MUNICIPAL OWNERSHIP OF PUBLIC UTILITIES.

In the last session of the Ontario Legislature, a Select Committee on Municipal Trading or Municipal Ownership or Operation of Public Utilities was appointed. The net result of the labors of these gentlemen is the publication of an epitome of the periodical and other literature produced within the last few years on these subjects, prepared by A. Pardoe, librarian of the Legislative Library. The report devotes 220 pages to reprints of articles for and against municipal ownership in Europe and the United States, and thirteen pages to the financial returns of municipal water, gas, electric light and street railway undertakngs in Ontario. While much credit is due to Mr. Pardoe for the vast amount of material he has compiled, it cannot be said that the labors of the seven gentlemen comprising the Select Committee have resulted in throwing any new light upon this important subject or in anything which would assist the public in arriving at the correct solution of the problem of municipal ownership. The desirability or otherwise of municipalities owning and operating public utilities is not to be decided by the evidence of writers and experts acting for interested corporations whose articles in many cases are published as paid advertisements, on the one hand; or of social reformers and economists on the other, but by the actual results of municipal systems in operation, and the benefits, if any, which the community at large obtain from such services.

It is to be regretted that the Select Committee did not see their way to present the people with an intelligent record of solid facts showing the comparative results of private and municipal ownership, rather than a confusing mass of controversial matter and figures which do not afford the average citizen any basis on which to form an opinion. We would here call attention to the misleading effect produced in the public mind by combining the terms municipal trading with the municipal ownership of public utilities. These terms have no relation to each other and therefore should be treated as separate subjects. Municipal trading means the trading by municipalities in commodities in which there already exists open competition among the citizens, such as the supply of electric light, gas, and water fittings; bakeries, dairy and agricultural produce, etc.; in fact any article in which the consumer is not at the mercy of a monopoly, and the provision of which by the municipality, means competition with the legitimate business of individual citizens. Municipal trading, as here defined, is wrong in principle, and should be discouraged in every way possible. There are, of course, some phases of municipal trading which can only be judged by the peculiar needs of individual localities, such as the housing of the poorer classes, model lodging houses, public baths, and other undertakings, which in crowded cities ameliorate the conditions of the poor and protect them from oppression, but fortunately the necessity for such does not exist to the same extent in Canada as in Europe, and therefore need not be here discussed.

Regarding the municipal ownership and operation of public utilities, this has been defined by the Right Hon. Joseph Chamberlain, than whom no better authority on practical public questions exists, in the following terms: "The true sphere of municipal activity is limited to those things which the community can do better than the private individual. To take a single illustration: It is evident that the main drainage and sewering of a town can only be undertaken by the representatives of the town as a whole, and cannot safely be left to, or, indeed, be possibly carried out by, each individual citizen for himself. But besides works which, from their magnitude, or from the necessity of concerted action in regard to them, must necessarily be placed in the hands of a central author-

ity, all undertakings which are in the nature of monopolies may also rightly be claimed as fit subjects for municipal control. The supply of gas and of water, electric lighting, and the establishment of tramways must be confined to very few contractors. They involve interference with the streets and with the rights and privileges of individuals. They cannot, therefore, be thrown open to free competition, but must be committed, under stringent conditions and regulations, to the fewest hands. As it is difficult, and, indeed, almost impossible, satisfactorily to reconcile the rights and interests of the public with the claims of an individual, or of a company seeking, as its natural and legitimate object, the largest attainable private gain, it is most desirable that, in all these cases, the municipality should control the supply, in order that the general interests of the whole population may be the only object pursued."

These words were spoken before municipal ownership had assumed its present proportions, but the experience of municipalities has taught the people that wherever a monopoly has been created in the use of the ratepayers' property by a private company, the stockholders have enriched themselves at the expense of the people, by the watering of stock and the exaction of excessive charges for inferior service, the municipalities being powerless to interfere, or even control their own streets. As a result of these practices, the corporations are themselves responsible for the growth of public opinion in favor of municipal ownership. Had they been satisfied with a reasonable profit on a capitalization free from water, and been less autocratic in their dealings with municipalities and the public, the present conditions would never have arisen.

On another page of this issue will be found data regarding the operation of electric light systems in Great Britain, from which it will be seen the price obtained by private companies is much in excess of the charges made by municipalities. This is one of the best testimonies in favor of municipal ownership. If a citizen can get a car ride for 3 cents instead of 5, gas at 60 cents instead of 80, or electric light at 8 cents per unit instead of 12, it requires a great deal of argument to convince him that municipal ownership is a failure.

It is well to note who are the opponents of municipal ownership, and on this point it is obvious to those who have studied the question that the opposing evidence comes in every case from the corporations who are struggling for existence. As an illustration of this, an association was formed in London, England, last year, called the "Industrial Freedom League," which posed as a disinterested society whose only object was to protect the poor citizens from losing their money in municipal ownership. A glance at the executive, however, revealed the fact that it was composed mainly of the directors and officers of the British United Traction Co., a corporation that had been endeavoring to monopolize the street railway franchises in all the Midland towns, and whose agents have been accused of buying votes at a shilling each to defeat a municipal street railway by-law in Birmingham. The Hon. R. Porter, late of the Standard Oil Trust; J. Pierpont Morgan, and other trust magnates also figured as patrons to the League.

Take the telephone question, again the only opponents whose evidence is worth anything in England consist of the officers of the National Telephone monopoly, J. E. Kingsbury, manager of the Western Electric Co., which is controlled by the American Bell Company, and, a recent arrival, H. L. Webb, late of the New York Telephone Co., also a Bell corporation.

There is no objection to an impartial investigation of this important question, but it must be admitted that evidence coming from the sources named, is absolutely valueless. As far as Canada is concerned, an enquiry into this subject by such a body as the Union of Canadian Municipalities, comprising as it does men of different views, and yet having the interests of municipalities at heart, might result in much good.

A stock argument used against municipal ownership is that sufficient allowance is not made for depreciation, yet they overlook the existence of a sinking fund which has an important bearing on the matter. Take, for instance, money borrowed for ten years to build a wall, the supposition being that it will last ten years. It deteriorates one-tenth each year, and one-tenth of its cost is repaid each year. Is this one-tenth not depreciation, for at the end of ten years there is no wall and no capitalization account? Examine a company's books using plant worth $5,000, and deteriorating ten per cent. per annum. A year after, the plant is worth $4,500 and from profits $500 is added to the account, and so on every year until the tenth, when you have no plant, and $5,000 capital indebtedness, which if paid off, would wipe out the $5,000 set aside for depreciation. Thus we have a distinction without a difference. It is interesting to note the inconsistency of this depreciation argument, for it is well known that the corporations do not practise what they preach in this matter. An examination of the Bell Telephone Co.'s accounts, for instance, reveals the fact that on January 1st, 1902, with a capital account of $6,750,000, the total amount of the contingent fund, after 22 years' existence, was only $900,000, while in that year nothing was set aside for contingencies, and only $50,000 was written off the plant and patent account. Many other examples could be shown in proof of the fact that companies do not make the provision for depreciation which they are so concerned about in municipal accounts. The explanation lies in the fact that companies construct and reconstruct their capital accounts, which municipalities do not, in order to provide for the renewal of their plant out of capital instead of revenue. In other words, their customers have to find the dividends on increased capital, while the stockholders go comfortably along without such an encumbrance as a sinking, and only an apology for a depreciation or contingent fund.

During the current year articles will be published in the "Canadian Engineer" dealing with the municipal ownership of public utilities, containing facts and figures regarding the operation of systems in Canada and other parts of the world, and at the same time comparisons will be made with the operations of companies, under similar conditions. It is not pro-

posed to publish the opinions of interested individuals, but rather to furnish records of actual results, leaving the public to form their own judgment. This, we believe, to be the only true method of assisting towards a satisfactory solution of the matter.

❧ ❧ ❧

—For the Canadian Society of Civil Engineers, the year 1903 has been one of great expansion, and Mr. Blackwell and his co-workers in the executive council can look back upon their term as one of greater progress than any in the history of the society. They have worked like beavers, and like that noble type of Canadian industry, have carried out their plans without undue noise and ostentation, building for the future. The membership of the society has increased notably, and its influence has extended in every province in Canada.

❧ ❧ ❧

ELECTRICITY AND FIRES.

One result of the recent terrible holacaust in Chicago has been to turn the attention of authorities in every city to the condition of the fire prevention and protection facilities of theatres and public halls. It is to be hoped that steps will be taken in this matter which will effectually prevent a repetition of such a catastrophe as that of the Iroquois Theatre fire. Some doubt exists as to the actual cause of the fire, although it is alleged that it was due to some of the stage drapery coming too close to a naked arc-light. Be this as it may, electricity is generally believed to have started the fire, and this raises the question as to whether sufficient precaution is taken in the equipment of electric light in buildings, to prevent fires occurring. In this connection it is well to note that following close upon the Chicago fire, the report of the Fire and Light Committee of Montreal for the last three months in 1903, records no less than 150 electrical fires, with losses aggregating $1,500,000. We have no reports from other cites, but there is reason to believe that in this respect Montreal is no worse than other places that make no such records, and these facts must seriously prejudice the public mind against the use of electricity. It is, therefore, in the interest of the electrical industry that attention should be called to this condition of affairs, and that some steps should be taken to ascertain its causes and remedy them.

An analysis of the Montreal report shows that twenty-two fires were due to crosses of telephone, telegraph and low potential wires with high tension circuits. Seven pole and tree fires are also recorded. It is clear that underground wires would have prevented these fires. Nineteen were due to wires grounded on gas pipes, eleven to defective wiring of fixtures, five by flexible cords wrapped round gas pipes, the current having punctured the pipe and the gas had ignited; three by short circuits in mouldings; three to open link fuses in porcelain cut out bases; fifteen to overheated resistance coils and heating devices, and nine to incandescent lamps coming in contact with inflammable material. It will be seen that all these fires were due to preventable causes, and this fact emphasizes the necessity of adopting some method of better supervision in the carrying out of electric light fitting and wiring, and also of educating the public in exercising proper care in the use of electrical apparatus.

In the report referred to, 135 fires are also recorded, where electricity was suspected as the cause, but could not be proved owing to conclusive evidence having been destroyed. Thus it will be seen that wherever a building in which electricity is used is destroyed, there is a tendency to put the blame down to this cause. It is therefore incumbent on electric light contractors to use every means in their power to carry out their work in the most perfect manner. Steps should be taken to ensure that every one undertaking this work is properly qualified and that only reliable material is used.

Unfortunately, the competition in this business has educated the public to sacrifice efficiency for economy, with the result that in this country, where there is no Government supervision, the class of material used in the wiring and fitting of electric light systems in buildings is much below the standard of that in Great Britain, so much so that notwithstanding the preferential tariff English makers cannot compete with the United States. The onus of the present condition of affairs lies upon the public who insist on the first cost of an installation at the lowest possible figure, they being too short-sighted to see the possibility of being "penny wise and pound foolish." Electrical engineers and contractors are not to blame in this matter, they are only too willing to put in the best work, if they get a fair price for it, and the time is now an opportune one for them to get together and devise some scheme which will result in the universal adoption of only the highest standard of material and workmanship in electrical installations.

❧ ❧ ❧

CANADIAN SOCIETY OF CIVIL ENGINEERS.

The annual meeting of the Canadian Society of Civil Engineers was held in the society's rooms, Dorchester St., Montreal, on the 26th, 27th, and 28th January, the president, K. W. Blackwell, in the chair.

There were present during the convention the following members:

From Montreal—K. W. Blackwell, W. J. Sproule, R. Bickerdike, Jr.; C. H. McLeod, W. McLea Walbank, Joseph W. Heckman, J. A. Jamieson, H. R. Lordly, Wm. Arch. Duff, Charles S. Leech, L. G. Papineau, H. Irwin, Ernest Marceau, J. M. Donaldson, George Holland, Henry Goldmark, R. M. Hannaford, W. M. Reid, Henry Holgate, Robert A. Ross, James S. Costigan, J. A. U. Beaudry, Marcil Beullac, H. G. Rogers, C. Percival Metcalfe, H. L. Jordan, R. S. Lea, A. W. Robinson, G. Fiset, R. S. Kelsch, A. A. Blanchard, S. Blumenthal, J. M. Nelson, E. Vautlet, K. B. Thornton, A. Dedman, J. A. Burnett, C. de B. Leprohon, Stuart Howard, T. W. Lesage, George Janin, Alcide Chausse, R. A. Kimber, J. G. G. Kerry, Lewis Skaife, John Kennedy, N. Hanson Greene, Dr. J. B. Porter, J. M. Shanly, F. H. Pitcher, John R. Barlow, J. Ewing, Gordon Grant, H. C. Grant, Wm Kennedy, Jr.; D. MacPherson, F. L. Gagnon, F. J. Gilman, O. Hall, E. Belanger, F. S Mattice, W. McNab, H. R. Ives, H. A. Haffner, Dr. A. Stansfield, A. D. Dubuc, R. H. Balfour, W. Redpath, J. L. Allison, J. N. Smith, J. W. G. Greey, P. W. St. George, F. L. Fellowes, G. B. Ashcroft, H. L. Price, G. Le Grand, A. D. Porcheron, J. H. Edgar, Hon. J. P. B. Casgrain, C. V. Corless, R. F. McIntosh, D. W. McLachan, M. J. Butler, George Kydd, W. F. Drysdale, W. D. Lawrence, C. R. Young, H. Idsardi, A. P. Joseph, F. C. Laberge, L. A. Herdt, Phelps Johnson, O. H. Cote, W. Chase Thomson, T. Kirk, E. B. Jost, F. P. Shearwood, F. Lambart, C. F. Ficks, F. S. Keith, H. W. Jones, F. A. Wallberg, T. M. Fyschc, C. C. Richards, J. Duchastel, Alex Peden, Jr.; A. F. Smaill, W. V. Taylor, E. Fusey, J. T. Lemire, S. F. Rutherford, C. L. Trimmingham, E. G. M. Cape, E. A. Rhys Roberts, Frank Peden, Fred. A. McKay., R. B. Kennick, C. N. Monsarrat, Le A. Desy, Arthur Marsey, W. P. Boucher. From Toronto—C. H. Rust, A. A. Bowman, C. E. Cooper, N. B. MacTaggart, Alfred J. Stevens. From Ottawa—C. P. Pinhey, A. S. Laurent, Louis Coste, Robert A. Surtees, W. Dale Harris, Col. W. P. Anderson, G. H. Blanchet, A. D. Harris, G. A. Mountain. From Quebec—Thomas Breen, A. Rhodes, G. G. Gale. From Levis—A. H. Larochelle. From Sorel—G. J. Desbarats, J. D. Lachapelle. From Charlottetown—R. A. Morrow. From Glace Bay—C. M. Odell. From Sherbrooke—C. K. Addie, J. T. Morkill. From Amherst—O. W. Smith. From Indian Lorette—Henry O'Sullivan. From Niagara Falls—G. A. McCarthy, A. C. Blanchard. From St. John's, Nfld.—H. C. Burchell. From Vancouver, H. E. Carry, G. H. Dawson. From Three Rivers—G. R. Duncan. From Ste. Anne de la Pocatiere—J. F. Serois. From Cornwall—A. L. Killaly. From Peterboro—Richard B. Rogers. From Iroquois—F. R. Wilford. From Carleton Place—F. T. Wilkie. From Ste. Anne de Bellevue

—J. L. Michaud. From Farnham—W. H. Benny. From Kingston—J. Sears, L. W. Gill, J. Grant, H. G. Goulet. From Brantford—F. C. D. Wilkes. From Barbados — Clifton H. Wright. From Hawkesbury — H. C. Kennedy. From Lindsay—H. W. D. Armstrong. From Pembroke—J. L. Morris. From St. Hermanegilde—D. W. Lippe. From Winnipeg—J. G. Sullivan.

After the reading of the minutes of the last annual meeting by the secretary, Prof. C. H. McLeod, the president, nominated the following as scrutineers of the ballots:

For election of officers and council: C. S. Leech, J. Ewing, Gordon Grant, R. A. Kimber, J. A. Burnett, and H. C. Grout.

For nominating committee: H. R. Lordly, C. P. Metcalfe, and M. Donaldson.

For amendment of by-laws: J. M. Nelson, and A. W. Robinson.

REPORT OF COUNCIL.

The following is a summary of the report of the council for the past year. There were elected during the year two honorary members, 28 members, 37 associate members, six associates, and 111 student members, in all 180, including two associate members reinstated. There were eight struck off for non-payment of dues, and eight deaths, leaving the membership roll as follows:

	Res.	Non-Res.	Total.
Honorary members	2	8	10
Members	72	306	378
Associate members	97	265	362
Associates	16	19	35
Students	112	250	362
Total			1,147

The total of previous year was 982, and an increase in each class was shown. The technical work of the society has during the latter half of the session, in accordance with the instructions of the last annual meeting, been conducted by four sections, Electrical, Mechanical, Mining and General. The papers were of a high order and the meetings well attended. The success of this plan of work warrants its continuance.

The committees on professional status were re-appointed, but no special action has been taken in regard to legislation in the provinces. In the Dominion Parliament, an application was made by a few engineers and others for the incorporation of an engineering society to be known as "The Dominion Institute of Amalgamated Engineering," but on coming before the Private Bills Committee the act was thrown out, by unanimous vote, on the reading of the preamble. Acting upon the suggestion of an ordinary meeting, the council addressed a letter to a number of Cabinet Ministers, asking their co-operation towards providing that none but Canadian engineers be employed on the Trans-Continental Railway surveys.

The proposed summer excursion did not meet with enough support to warrant carrying it out.

The Gzowski medal for the year 1901-02 was awarded to H. D. Bush for his paper upon "The Erection of the Alexandra Bridge at Ottawa," and the committee on the award for 1902-03 has reported, recommending the presentation of the medal to A. W. Robinson for his paper on "The Hydraulic Dredge, King Edward VII."

The examiners appointed for the award of prizes for students' papers, recommended an award as follows:

Electrical—E. A. Foreman for his paper on "Core Type Transformers."

Mechanical—S. Gagné for his paper on "Mechanical Wood Pulp."

Mining—Norman W. Parlee for his paper on "Methods of Mining and Timbering Large Ore Bodies in British Columbia and Michigan."

General—G. H Blanchet for his paper on "Trans-Continental Transportation."

A committee of council had a conference with the Government in connection with the remodelling of the Canadian Patent Laws during the last session of Parliament. The committee appointed to consider the practicability of inaugurating the measurement in connection with the flow of streams, has held several meetings and will report during the meeting. The council obtained the opinion of its solicitors in regard to the standing of the society under the Quebec Act, 61 Victoria, chapter 32. This opinion is to the effect that the Act cannot be affected either as to its validity or effectiveness by non-user.

The report concluded with a biographical sketch of the late Thomas Munro, president of the society in 1895.

TREASURER'S REPORT.

H. Irwin, treasurer, presented his report which showed that the society held its annual meeting for the first time in a building entirely free from debt, the mortgage of $2,000 having been paid off last July. The arrears of fees received last year were almost double those paid during 1902. There was an increase in current fees of $760, during 1903, as compared with 1902, and a corresponding increase of $103 in advance fees. The increase in entrance fees amounted to $350. There was an increase during 1903 of $2,210 in total receipts, as compared with 1902. The total expenditure out of the general fund for 1903 amounted to $6,682.35, but from this should be deducted an extraordinary expenditure of $1,247.68 in part payment of the mortgage on our property, leaving an ordinary expenditure of $5,434.67, which is $168.88 less than total expenditure during 1902. There was an increase this year of about $600 in cost of transactions, printing, etc., and a decrease of about the same amount in cost of furniture and legislation expenses. An estimate of the value of books and furniture has been prepared by the librarian, assisted by an expert valuator, so that the statement of assets and liabilities can now be entered in a complete form..

LIBRARIAN'S REPORT.

The report of the librarian, E. G. M. Cape gave a list of twenty-five books of reference purchased, and a number of donations of books and pamphlets during the year. A list was given of the engineering papers subscribed for or received as exchanges. The receipt of portraits of two past presidents—W. T. McN. Thompson and Thomas Monro—was acknowledged, the former having been presented by Mr. Thompson's family and the latter by several members of the society.

The reports were adopted, on motion of J. M. McCarthy, seconded by H. R. Lordly.

The treasurer in his report, having referred to the proposal to allow a rebate of $2 from the fees of members outside of Montreal who desired to form branch libraries, R. A. Ross expressed the opinion that something should be done at once to carry out the suggestion of having branches of the society in the chief cities of Canada. The American Institute of Electrical Engineers adopted this plan in the United States, and had moreover a branch in Canada, one having been recently formed in Toronto. He moved that it be an instruction to the incoming council to take up the question of establishing such branches with power to refer it to a committee to do what is necessary to that end.

The motion was seconded by Ernest Marceau.

The president said he presumed the motion, if adopted, would carry with it the power to grant pecuniary aid to the branches.

H. Irwin said that the proposed rebate of $2 per member was to aid in the formation of branch libraries, but he would approve of giving financial aid to the extent of $500 in certain cases to put the branch on its feet.

C. S. Leech thought this would be moving in the dark, and that it would be better to take the opinion of local members in the chief centres before taking action.

Henry Goldmark said the only society he knew of which had branches in the way proposed was the American Institute of Electrical Engineers. It appeared to have been very successful in its plan.

On the suggestion of a member, Mr. Ross added a clause to his resolution giving council the power to deal with the financial side of the question, and the resolution, as amended, was carried.

Louis Coste, of Ottawa, brought up a question of privilege in connection with the presentation of J. A. Jamieson's

paper on the "Pressure of Grain in Bins," which he complained contained personal references.

Mr. Jamieson said he mentioned no names in his paper, and did not mean to be personal, but desired to give facts as they were, and to present the results of his investigation into grain elevator construction.

After further discussion, a committee, consisting of the retiring president, the incoming president, and the vice-president, (Messrs. Blackwell, Anderson and Marceau), were appointed a committee to investigate and report, the report to be sent to every corporate member.

On motion of L. Skaife, seconded by C. de B. Leprohon, it was decided to ask the incoming council to formulate a rule by which one of the vice-presidents should be put in the place of seniority for the position of president.

The afternoon was taken up chiefly with the reading and discussion of Dr. Stansfield's paper on Electricity in the Metallurgy of Iron. The lecture, which was illustrated by lantern slides, showing on the screen the actual effects produced in the smelting of metals in an electric furnace in use in the room, was very instructive. It will be referred to in another issue.

The evening was taken up with a lecture by M. J. Butler on the new shops of the Locomotive and Machine Works, Longue Pointe, and one by Henry Goldmark on the new shops of the Canadian Pacific Railway in East Montreal, both lectures being well illustrated.

WEDNESDAY, 27TH JANUARY.

The day was spent in visiting the works above mentioned. The Montreal Street Railway kindly provided special cars for the trip, and Mr. Macdonald, the superintendent, accompanied the party. A generous lunch was provided by the Locomotive and Machine Co., M. J. Butler, the chief engineer, acting as host at the table and as guide through the works. Henry Goldmark performed the same service in the same agreeable manner at the C.P.R. shops.

THURSDAY, 28TH JANUARY.

The first business of the day was the amendment to by-laws, which had been submitted to ballot in November, and which were carried as follows:

To amend by-law 19 by adding "Student members who are also active members of an Engineering or Scientific Society in any University or Engineering school in Canada may, with the approval of the Council, have one dollar of the above fee remitted to them.

(New By-Law.)

21a. On the first of July of each year, interest amounting to two and one-half per cent. shall be added on each succeeding first of January and first of July until the said fees be paid. This interest shall be collectible in the same manner as the annual fees.

To amend By-law 27, by changing the last sentence to read: "Of the fifteen councillors elected, at least eight shall be representative of the four sectional departments of engineering, not less than two for one section, having been nominated as such. Of these representatives of sections, at least one for each section must be resident at headquarters."

(New General Heading.)

28a. There shall be four sections of engineering in the Society, viz.: Electrical, Mechanical, Mining and General. At its first meeting after the annual meeting, the Council shall name for each section a president and a vice-president, both of whom shall be members of Council, and at least one resident at headquarters, to hold office for one year from the first day of June next following. Each section may at its first meeting appoint a member, associate member, or student to act as recording secretary at all meetings of the section during the year. The several sections are empowered to extend the privileges of their meetings under such conditions as they may prescribe to engineers not members of the Society, or other persons interested in engineering. The papers read and discussed by each section shall be published in the Society's transactions, if approved by the committee on papers.

To amend By-Law 29 by adding: "The sectional meetings shall be presided over by the president or vice-president of the section, or, in their absence, by a member of the Society."

To amend By-law 35, second paragraph, to read: "This list shall contain at least 34 names of members, viz.: One for president, five for vice-presidents, one for treasurer, one for secretary, one for librarian, and twenty-five for councillors, and of the twenty-five nominated as councillors at least eight shall be representative of the four sectional departments, not less than two for each, and at least eight of the twenty-five must be resident at headquarters. Amongst the eight resident at headquarters must be included at least four representatives of sections, at least one for each section, nominated as such. The list shall be signed by a majority of the Nominating Committee."

To amend 44 (C) by changing the words preceding "during the months of October," to read as follows: "Ordinary meetings of the Society, or of one of the sections thereof, shall be held at eight in the evening of every Thursday.

The ballot for the nominating committee resulted as follows:

For Ontario—Cecil B. Smith, Richard B. Rogers, and Professor John Galbraith.

For Quebec—W. McLea Walbank and G. L. Papineau.

For the Maritime Provinces—F. W. W. Doane.

For N.W.T. and British Columbia—George A. Keefer.

For Newfoundland and Foreign—H. Irwin.

The following were elected

OFFICERS FOR 1904:

President, Col. W. P. Anderson; vice-presidents, Ernest A. Marceau, C. E. W. Dodwell, and C. H. Keefer; secretary, Prof. C. H. McLeod; treasurer, H. Irwin; librarian, E. G. M. Cape; council, G. H. Duggan, John Kennedy, W. McLea Walbank, M. J. Butler, H. J. Cambie, Phelps Johnson, P. W. St. George, D. McPherson, W. R. Butler, R. B. Rogers, Cecil B. Smith, W. B. Mackenzie, Prof. R. B. Owens, E. H. McHenry, St. George Boswell.

Mr. Blackwell then delivered his presidential address, in substance, as follows:

PRESIDENT'S ADDRESS.

This is an age in which everything is measured by results. Some results are measured in dollars and cents, others in "kilowatt hours," and others in "foot pounds" and "ton miles," etc. It is probable that a large number of our members are interested in the question of "ton miles." The economies that have been brought about in transportation on this continent are so much in advance of what has been done in England, and Europe generally, that I have confined my remarks to the ton mileage results of this continent, and in the American Atlantic trade.

In speaking on this subject, Mr. James J. Hill, of St. Paul, who is president of the largest system of railways in the world, when addressing the members of the Commercial Club of St. Paul, remarked as follows: "Regarding land transportation in Great Britain, it costs $2.35 on an average to haul a ton of freight 100 miles; on the continent of Europe it costs $1.90, and in the United States 70 cents. We pay four times the wages they pay, and yet we furnish the transportation for little more than one-third of the average of Europe, and still we are hardly happy."

The engineer, who is interested in works that have brought about such gratifying results commercially, is now invited to look at the following table of freight rates reduced to a ton mileage basis:

ALL RAIL RATES.

	Rate.	Miles.	Per Ton per Mile, Cents.
Chicago to Portland, grain, per 100 lbs ...	10c.	1138	[illegible]
Chicago to New York, grain, per 100 lbs.	16c.	971	.37
Brandon to St. John, N.B., grain, per 100 lbs. ...	35c.	2038	.37
Springhill, N.S. to Montreal, coal per ton ...	1.80	738	.25

LAKE AND RAIL RATES.

	Rate.	Miles.	Per Ton per Mile, Cents.
Chicago to Montreal, grain, per 100 lbs.	13c.	1080	26
Brandon to St. John, N.B., grain, per 100 lbs ...	25c.	2038	22

Chicago to Montreal, (via Canada Atlantic), grain, per 100 lbs.	8c.	827	.21
INLAND WATER RATES.			
Duluth to Cleveland, iron ore, 80c. per ton..		875	.09
Chicago to New York, grain, via Erie Canal, 9c. per 100		1330	.15
Chicago to Montreal, grain, 12c. per 100......		1175	.23
Duluth to Quebec, grain, 12c. per 100		1580	.17
OCEAN RATES.			
Montreal to Antwerp, grain, 1s. 3d. per qr...		1250	.044
Antwerp to Montreal, steel rails, 7s.3d. per ton		3250	.053
Montreal to Liverpool, grain, 1s. 3d. per qr...		2900	.046

The rates in the foregoing table are all important commercial examples, and cannot fail to convey to the mind of the engineer exactly what has been accomplished up-to-date. In putting forward these rates, no effort was made to search for isolated cases of unusually low rates, but rather to furnish an idea of what the regular every day freight rates actually are. To what extent these rates can be bettered by engineering improvements is the interesting point. The foregoing rates per ton per mile are not of course the average rates which apply on miscellaneous articles, but are the low long haul rates which obtain to-day in the handling of grain, coal, iron, etc., and which constitute the greatest part of our tonnage. These splendid results from an economical point of view are what you are invited to consider.

Let us analyze the details of the water carriage of iron ore from Duluth to Cleveland, Ohio. The particulars of a standard ore carrying lake steamer are as follows: Length 416 ft., keel over all 436 ft., 50 ft. beam, 28 ft. depth moulded, carrying capacity 6,500 gross tons of iron ore, consumption of coal on round trip of 875 miles, going up light and returning with ore, 180 tons, approximate value of boat, $280,000. The engines of this boat are of the vertical type with three inverted cylinders, diameter of cylinders being 22 in., 35 in. and 58 in. by 42 in. stroke, indicating 1,300-h.p., which propel the boat 11 miles per hour. Cost per day for wages about $70. This steamer can be loaded from the ore pockets in 50 minutes, and unloaded by mechanical means in six or seven hours. You will observe that this ore business is done at .09 of a cent per ton mile at present, when rates are supposed to be very remunerative. And it is a well-known fact that these vessels have made profitable returns on a 60c. rate, which is .06 of a cent per ton per mile, or in round numbers less than 1-10 of the average rate of freight per ton per mile that is earned by the railways of this continent. It may be interesting to you to know, because it confirms these figures, that the Dominion Coal Company find by their large experience in the transport of coal, of say about 1,000,000 tons per annum, from Sydney to Montreal, that the actual cost of transportation owning or chartering their own vessels is 55c. per ton for the distance of 780 miles or say about .06 of a cent per ton per mile.

The history of the competition between the Erie Canal and the railways paralleling it is most instructive in connection with this question of cost of carriage per ton per mile. The present old fashioned canal boats have a capacity of 240 tons, and the grain rate this summer from Buffalo to New York by canal was 2.6c. per bushel, or .23c. per ton per mile, and while it is a fact that the parallel roads were charging nearly four cents per bushel, or say .35c. per ton per mile for the same haul, the canal is now more or less out of business, and many of the boats laid up. This state of affairs has been brought about by the railways, which on more than one occasion during the last few years, made a cut on the grain rate from Buffalo to New York, to 2.5c. per bushel, which so disturbed the canal traffic as to leave the railways the masters of the situation. The tax-payers of the State of New York have now decided to spend $110,000,000 in enlarging the Erie Canal, giving it a depth of 12 ft. so that 1,000-ton barges can be used, and the rates reduced to .06 of a cent per ton per mile, or less than 3/4 of a cent per bushel, Buffalo to New York. The New York State Canal Committee, after a careful enquiry into this matter, reported that there was no probability of the railways ever being able to carry freight at .1 of a cent per ton per mile, which would be a guarantee of the continued and uninterrupted value and usefulness of the canal to the State. I think you will agree that the estimate these commissioners made was a pretty safe one, and that the figures have a most important significance with reference to the whole question of the relative cost of land and water transportation.

The exhibit given in the table of rates on the Atlantic shows still lower rates per ton per mile, but it is generally conceded by shipping men that these rates are more or less unprofitable and are about rock bottom. While shipping men are not holding out hopes of any substantial reduction in rates in the near future, railway men on the other hand appear to be alive to the possibility of further economies.

The present comparatively low railway freight rates have come from many causes, larger locomotives, larger cars, and the practice of making up train loads to the full capacity of each locomotive, and also to that most important work of improving the grades and curvature. This last question is one to which all railway officers are now fully aroused. It is with them the most important question of the hour. Nearly every railway company in good standing financially is making marked progress in this respect. The railway president of to-day, who has mapped out a plan of improvement for his road that will result in a reduction of controlling grades of say from one per cent. to four-tenths of one per cent., has, so to speak, a "level head." Such a change will reduce the cost of hauling freight per ton per mile very largely, and he will be able to give to the community served by his road lower rates, and at the same time place the railway in a better position to give its shareholders fair returns on their investments.

A very brief examination of the subject of engine loads upon varying gradients affords the most convincing proof of the value of easy grades. A. M. Wellington, in his work on the economic theory of railway location, gives the following figures to show what is a working load of a locomotive upon various grades. For instance he sets forth in his tables that an 18 by 24 freight engine could haul the following load of net tons on varying grades as under:

Load Rating for 18-in. by 24-in. Locomotive, in Net Tons, Including Weight of Cars.

Incline of Grade.	Total load in net tons, Mr. Wellington's Table. Tons.	Total load in net tons, C.P.R. Ratings. Tons.
Level	2,183	
1/10 of 1 per cent............	1,733	1,500
2/10 " 1 "	1,433	1,400
3/10 " 1 "	1,219	1,300
4/10 " 1 "	1,058	1,200
5/10 " 1 "	933	1,100
6/10 " 1 "	883	1,000
7/10 " 1 "	751	900
8/10 " 1 "	682	800
9/10 " 1 "	625	700
One per cent.	578	607

I have examined the working ratings and loads for locomotives, as adopted by the Canadian Pacific Railway, after they had arrived at the same by making an exhaustive investigation of the subject by aid of a dynamo-meter car, and find that they work out approximately as shown. This is an interesting and satisfactory comparison.

In explanation of the discrepancies in the above table, it must be remembered that a level piece of road free from the complications of curvature is very rare, and Mr. Wellington's figures giving the load for a level piece of road as 2,183 tons were no doubt arrived at after making a test on an ideal piece of level tangent which is hard to find in actual practice. The question also of speed has to be considered very carefully in making a comparison of this nature.

With regard to possible further reductions in rail rates in the future, I have analyzed the results of some of the most economically operated railroads on this continent, as shown in Poor's Manual. The public of this country are paying on an average, as before stated, about .70 of a cent per ton per mile for their freight rates by rail, but at the same time a large amount of mineral and grain traffic is handled, as

shown in this paper, below .35 of a cent per ton per mile. In fact that remarkably well equipped railway, namely, the Bessemer and Lake Erie, which handles most of the iron ore coming from the Great Lakes to Pittsburg, is able to show very good returns on its capital and make extensive betterments to its system at the same time, on an average rate of .4 of a cent per ton per mile. The tonnage statistics as published in the annual report of this road, are of great interest, and having one of the heaviest mineral traffics in the world, it has conditions for making a good showing, which are quite ideal; for instance, its average load of freight for last year on South bound iron ore trains was 1,479 tons, and its average train load for North and South bound trains was 913 tons. These are remarkable figures, and are more than 100 per cent. better than are shown by such roads as the Transcontinental systems, all of which handle a mixed traffic, and the train load results which they show of from 300 to 480 tons per train mile is all that can be expected under the circumstances. With regard to the future of railway rates, a study of the subject forces one to the conclusion that railway companies are so progressive and enterprising, that, given a large and steady volume of traffic, they will equip themselves to carry it cheaply, as the Bessemer and Lake Erie Railway and others have done, and that in the future we shall see rates that are substantially lower than those we have considered in this paper. It is generally conceded that the rapid progress that has been made by the railways in operating economies has been largely brought about up to the present time by the improvements that have been made in locomotive and car construction. The latest statistics obtainable on the trainload questions as given below, would indicate that the rate of improvement in the train load figures have not been so well maintained during the past year, and that the yearly improvements in the train load, which have been accomplished by increasing the size of locomotives and cars, have about reached their limit.

TRAIN LOADS INCREASED.

	1903.	1902.	1901.	1900.
Lehigh Valley	485	466	463	429
Atchison	279	247	242	221
Illinois Central	288	274	235	221
New York, Ontario & West.	287	285	290	287
Norfolk & Western	486	476	461	345
C., C., C. & St. Louis	333	332	333	335
St. Louis & San F.	195	186	200	154
Wabash	302	285	283	269
Toledo, St. Louis & W.	295	285	250	..
Wisconsin Central	303	286	260	258
Erie	406	376	375	369
St. Louis South West.	252	232	210	207

TRAIN LOADS UNCHANGED.

	1903.	1902.	1901.	1900.
New York, N. H. & H.	218	218	208	204
Louisville	231	231	222	239

TRAIN LOADS DECREASED.

	1903.	1902.	1901.	1900.
Northern Pacific	344	346	324	317
St. Paul	244	254	237	205
Southern	193	195	192	170
Chesapeake & Ohio	493	509	511	488
Chicago & Great West.	277	291	313	261
Chicago & New Orleans	231	249	232	235

In order to make further reductions the railways must continue the work of cutting down their grades, and will also probably obtain additional economy from the adoption of the alternating current electric locomotive. The question of coal consumption in relation to ton mileage is also of interest, in large freight vessels fitted with marine engines of the most advanced type for fuel saving, a consumption of 2.5 lbs. of coal per 100 ton miles of freight carried, has been claimed as a record, but marine engineers generally regard a consumption of 5 lbs. of coal per 100 ton miles as the average. Whereas the consumption of coal upon railways is about 19 lbs. per 100 ton miles.

I commenced my early engineering training in locomotive work, and have the highest appreciation of the locomotive in all the stages of its wonderful development. But it would seem that it has now nearly reached its limit, and is destined to be out-classed by a machine which will merely consist of a group of four or more electric motors mounted on as many driving axles. There is no doubt that such electric apparatus has been designed and can be built upon the basis of the electrical engineering science as it now exists, and that such a machine would give better results than the locomotive in fuel economy," "Draw Bar Pull," and the economical and elastic distribution of wheel load with reference to wear and tear on rails, road bed and bridges.

There is no data in existence based upon results that can lead us to any definite conclusion as to what the relative consumption of fuel and power would be as between the handling of freight trains as they are now handled by steam locomotives, compared with the electric locomotive driven from a central power station.

Still we have the very instructive and significant comparison which exists between the fuel consumption on steam tram cars, as compared with the consumption on electric cars in street railway service. In the case of the former, the consumption of coke, which is the usual fuel used, is 15 lbs. per car per mile, and in the latter 8 lbs. of coal per car per mile.

The address was received with applause, and the retiring president was complimented on the practical turn of his departure from tradition in selecting his topic.

Colonel Anderson, the president elect, was then invited to take the chair, and expressed his appreciation of the honor done him in placing him in the highest position to which a Canadian civil engineer could aspire.

Votes of thanks were then passed to the retiring president and other officers, to the street railway company, and the companies whose works were visited, to the railway companies for special rates of transportation, to the press, and the dinner committee.

On motion of H. R. Lordly, seconded by F. C. Laberge, the incoming council was instructed to appoint a special committee composed of one representative each from the Mechanical, Electrical, Mining and General sections to prepare a card index system for trade catalogues and other current publications, and a similar index of current technical literature to be used for the reference library and to be kept up-to-date. The council was authorized to incur any necessary expenditure up to $100.

Mr. Lordly also brought up the subject of Sunday opening of the rooms, and said that less than twenty different people had used the rooms on Sunday during the whole year, while the caretaker was kept on duty during the whole day. After discussion, it was decided to limit the Sunday hours to 9 to 10 a.m., and 2 to 4 p.m., the rooms to be entirely closed on Sundays in July and August.

This closed the business of the convention. In the afternoon the members entertained a number of friends to a tea, to which a large number of lady friends were invited.

A meeting of the general section was held the same evening to hear the reading and discussion of Mr. Jamieson's paper on Grain Pressure in Bins, and the reading of a paper by J. J. Taylor on the Shubenacadie Bridge. These papers are crowded out of this issue. The meeting closed with "God Save the King."

The annual dinner of the Society was given at the Windsor Hotel, on Wednesday evening, 27th January, and was a very successful reunion. Mr. Blackwell occupied the chair, and was supported by Col. Anderson, the president elect. The principal toasts were, the "Sister Societies," proposed by R. A. Ross, and replied to by Senator J. P. B. Casgrain and B. T. A. Bell; "Our Guests," acknowledged by M. J. Connolly, president of the Locomotive and Machine Co.; "the Society," proposed by G. A. Mountain and responded to by E. A. Marceau; the "Retiring Officers," proposed by Col. Anderson and replied to by K. W. Blackwell, the "Visiting Members," proposed by Major Stuart Howard, and responded to by R. B. Rogers, and Henry O'Sullivan, and the "Press," proposed by W. McLea Walbank, and responded

to by representatives of the Engineering News of N.Y., and the Canadian Engineer. The songs of the evening, for which the society was indebted to Messrs. Poole, Bowman, Courtice Brown and O'Sullivan, were very much enjoyed. The entertainment committee was specially thanked in the closing toast of the evening.

Col. W. P. Anderson, President Canadian Society of Civil Engineers, 1904.

Col. Anderson is chief engineer of the Department of Marine and Fisheries, Ottawa. A biographical sketch of the new president appeared in the Canadian Engineer for March, 1902.

INDUSTRIAL NOTES.

Alex. Webber will erect new boiler workshops, at Dartmouth, N.S.

The brass and steel works, at Stouffville, Ont., have been sold under a mortgage.

The Frost Wire Fence Co will move its factory from Welland to Hamilton, Ont.

The foundry of Frost & Wood, Smith's Falls, Ont., was consumed by fire on January 7th.

The Western Foundry Co., of Wingham, Ont., have established a branch in Winnipeg.

T. McAvity & Sons have purchased the Whelpy skate factory, at Greenwich, Sussex, N.B.

The Vulcan Iron Works, Winnipeg, Man., will build new boiler, blacksmith and machine shops.

The Government contract with the Ross rifle factory, Quebec, calls for the delivery of 1,000 rifles monthly.

The Dodge Manufacturing Co., of Toronto Junction, have opened a branch at 419 St. James street, Montreal.

Hugh McDonald, of North Sydney, C.B., will, this spring, build a wharf at Big Pond, C.B., estimated to cost $10,000.

The Sydney Manufacturing Company, Sydney, C.B., contemplate enlarging their plant, to include the manufacture of cars.

Fires occurred at Aitchison's planing mills, Hamilton, Ont., on December 25th and January 16th. Incendiarism is suspected.

The Perth Solid Steel Car Wheel Company is in operation, after several years' stoppage, and has a daily output of ten wheels.

The Bridge and Structural Works bonus by-law, at Galt, Ont., was defeated by 59 votes. It will probably be submitted again.

The Pere Marquette car shops will be removed from Walkerville, Ont., to St. Thomas, which town has granted $20,000 bonus.

The result of the surtax on German goods is a decline of 40 per cent. in the imports from Germany in the three months ending December.

The Kingston Locomotive Works, have enough work to last till October, and are refusing orders owing to the uncertainty of the steel market.

The new works of the Canada Radiator Co., at Lachine, Que., are fast approaching completion. The plant has a capacity six times that now at Port Hope, Ont.

The Canadian Elevator Co., Winnipeg, Man., with which is associated the American Cereal Co., Peterboro, Ont., will build an elevator at Port Arthur, Ont., of 1,250,000 bushels' capacity; also immense storage warehouses.

The Jeffrey Manufacturing Company, of Columbus, Ohio, through its connection with the Ohio Malleable Iron Company, of the same place, are now in the field soliciting orders for high grade malleable castings.

The new mills of the Echo Milling Co., Gladstone, Man., were started on January 13th. The capacity is 250 barrels a day. The Goldie-McCulloch Co., Galt, Ont., supplied the mill machinery, and the Vulcan Iron Works, Winnipeg, the elevator plant.

Canada's Pavilion at the World's Fair is finished. The structure is one of the most ornate among the many attractive foreign buildings, and occupies an advantageous site north of the Palace of Agriculture. The intra-mural railway passes the main entrance.

The Smooth-On Mfg. Co., of Jersey City, have issued a booklet telling about Smooth-On, its different combinations and their applications. The latest combination is Smooth-On with rubber, which makes an excellent sheet packing, that will withstand very high temperatures and pressure. Catalogues will be sent to anyone asking for them.

The Sunbeam Incandescent Lamp Company, of Toronto, are placing on the market a special Mill type lamp, for use in factories having a number of running belts. The difficulty with ordinary lamps for moving belts is that the filament is attracted to the glass by static electricity. In the Mill type, is a double-anchored filament lamp, which overcomes this difficulty.

The Packard Electric Co., Limited, makers of lamps, transformers and meters, write to thank their many customers for orders during the past year, and state that the uniformly high standard of their Packard lamps, type "G" meters and type "R" transformers will be maintained. The lamp department has recently been increased in capacity so that orders may be shipped quickly.

An English company, manufacturing ice-making and refrigerating machines, wish to find an engineering firm in Canada who would purchase their Canadian patents or manufacture the machines under royalty. The company make several types of refrigerators, which may be operated by electricity, gas, oil or steam. A. C. Leslie & Co., Montreal, will be pleased to supply further information.

Among recent installations of the Cyclone grate bars, by P. E. Durst & Co., Yonge St. Arcade, Toronto, are: The Elliott Mfg. Co., the School of Practical Science, the Toronto Technical School; J. F. Brown Co., Limited, the G.T.R., Jones & Moore, the Rolston Laundry Co., Toronto, the Kingston Hosiery Co., Kingston; the Crown Furniture Co., Preston; Normal School, London; Alex. Mann, and Flumerfeldt Bros., Orangeville.

The France Packing Co. have secured from the Rapid Transit Subway Power-house, New York, a contract to pack the piston rods of all engines with their "Steam Stopper" metallic packing. They also acknowledge the support given their new "Steam Stopper" and "Water Stopper" brands of fibrous packing. They have placed on the market a new high pressure packing ring, made of the finest long-fibre asbestos yarn, and spun with a metallic wire, which has met with success, a number of railroads having adopted it exclusively for use on their locomotive air pumps. Their 1904 catalogue is ready, and can be had on application.

J. L. Allan, of the Hamilton Motor Works, Hamilton, Ont., has assigned, and the business is on the market. W. G. E. Boyd is the assignee.

The council of East Toronto will issue debentures, value $25,000, to purchase a factory site, and loan the Globe Manufacturing Co., Walkerville, Ont., $20,000.

The Cling-Surface Mfg. Co., of Buffalo, N.Y., announce that their product, Cling-Surface for belts, will now be handled in Ontario and the Western provinces solely by the Eureka Mineral Wool and Asbestos Co., James Sinclair, manager, 74 York St., Toronto, or their agents. The Eastern provinces will be supplied as heretofore from the Boston office, 170 Summer street.

The Lunkenheimer Company, Cincinnati, makers of brass and iron steam specialties, report that owing to the unprecedented demand for their specialties, they have again greatly increased their facilities, and are now in a position to guarantee reasonably prompt shipments. They also report, through their foreign branches, an increasing export demand, and announce that they will shortly place some new lines upon the market which will be described in a very complete catalogue to be issued in the course of a few months.

The Dominion Tar and Chemical Company, Limited, commenced operations in October last, and is now in full working operation at Sydney, Nova Scotia. It is engaged in the distillation of coal tar on the most modern principles, and has equipped the largest distillery on this continent. The chief products are pitch for patent fuel making, roofing, etc., and creosote oil of all grades either for timber preservation, creosoting, lighting, etc. The company is shipping, besides these products, many specialties, such as specially prepared varnishes, disinfectants, etc. The works are fully equipped with railroad sidings in direct touch with the I.C.R. system and with the Sydney shipping piers. The president of the company is S. B. Boulton, who is the largest tar distiller in the world, and the oldest authority on timber creosoting.

RAILWAY NOTES.

The projected extension of the Hampton-St. Martin's Railway to St. John, N.B., will be built this year.

The Cape Breton Electric Co. will inaugurate an express service between Sydney, Glace Bay, and other mining towns.

The North Easthope, Ont., council will give a bonus of $2,000 to the Berlin, Waterloo, Wellesley and Lake Huron Railway.

The G.T.R. will build a new bridge across the narrows at Orillia, Ont., and will relay the line from Gravenhurst to North Bay with new 80-lb. rails.

The contract for the substructure of the swing bridge on Lachine Canal, on the site of Brewster's bridge, has been let to John Quinlan & Co., Montreal.

The promoters of the Windsor, Essex and Lake Shore Electric Railway have obtained a 50-year franchise, and 21 years' exemption of taxation from Windsor, Ont.

The G.T.R. has ordered 15,000 tons of the best English rails, at $23.50 per ton, as against $26 for 25,000 tons of United States rails bought by the Canadian Northern.

An electric railway from Fredericton to Woodstock is projected. The Shaw-Cassells Co. are said to be willing to put $100,000 in the road. Power will be generated at Pokiok Falls.

Efforts are being made to induce the T.L.E. and P. Railway, recently built from Port Burwell to Ingersoll, and which is to be extended to Berlin and Collingwood, to run through Guelph, Ont.

Work has been started in Nebraska, on the Winnipeg, Yankton and Gulf Railway, to run from Lake Winnipeg through the Mississippi valley to the Gulf of Mexico. Winnipeg will be the northern, and Galveston the southern terminus.

The first regular passenger train on Chateauguay and Northern and Great Northern Railways was run from Montreal to Quebec on January 11th, leaving at 8.45 a.m., and arriving at 7.40 p.m.

The Winnipeg, Selkirk and Lake Winnipeg Railway is seeking powers to construct a belt line and to operate within the city of Winnipeg, Man. Also to build to Tyndall and Winnipeg river.

Daly & Crichton, Winnipeg, Man., have given notice of an application for powers to construct a railway from the international boundary to Winnipeg, Brandon, Portage la Prairie, and other points in Manitoba.

A daring attempt was made on January 10th to wreck the power plant of the Brantford street railway, by driving spikes through the generators. The spikes were, fortunately, discovered before any damage was done.

The Railway Commission will comprise the Hon. A. G. Blair, chairman; the Hon. M. E. Bernier, and Prof. J. Mills, of the Ontario Agricultural College, Guelph. The chairman's salary is $10,000, and the other commissioners $8,000 each.

Brown Bros., of Richibucto, N.B., completed seven miles of line from the Imperial Coal Co.'s mine, Beersville, to the I.C.R., at Adamsville, for the Beersville Railway Co., on December 22nd, having only commenced the work on Sept. 21st last.

The Temiskaming Railway Commission has awarded the following contracts: Angle bars, 15,500, Hamilton Steel and Iron Works; spikes, Pillow & Hersey Manufacturing Co., Montreal; bolts, Toronto Bolt and Forge Works; nutlocks, W. C. Nun, Montreal.

J. P. Geddes, of New York, manager of the Canadian Coal Mining Co., has applied to the New Brunswick Legislature for a charter to build a road from their mine in Kent County to Richibucto, eight miles; to the I.C.R. at Coal Branch, six miles, and to Chipman.

Advices from Guatemala state that American and Canadian capitalists will complete within three years the Northern Railroad into Guatemala city, completing the inter-ocean railway for a distance of 270 miles. It will transfer the commerce of Guatemala from the Pacific to the Atlantic.

The Hampton and St. Martin's, N.B., Railway is closed until spring. Repairs will be made to the road before reopening, 15,000 new sleepers are to be put in, the bridges will be overhauled, and some new rolling stock will be secured.

A report from a reliable source states that Port Simpson has been decided upon as the Grand Trunk Pacific terminus. Also that the main line will not touch Winnipeg, but that Mackenzie & Mann's system west of that point will be acquired.

The Ottawa and New York Railway got $73,000 bonus for constructing a railway to Ottawa, Ont., and establishing workshops there. It is claimed that the shops were erected but the equipment remains at Santa Clara, N.Y., where the greater part of the work is done. The city council proposes to take action in the matter.

The stations on the Lindsay, Bobcaygeon and Pontypool Railway, will be Blackstock, six miles north of Burketon; Lindsay, Dunsford, and Bobcaygeon, also two flag stations not yet located. Delivery of 4,000 tons of 60-lb. rails of Belgian and German make, with 24-inch angle-bars for this line, is due early in the spring.

The new I.C.R. roundhouse, at St. John, N.B., costing $72,000, is nearing completion. It comprises engine house, machine house, water tank holding 100,000 gallons, and turntable, the latter being set and furnished by the Hamilton Bridge Co. The Sturtevant hot air system is used for heating the machine shops.

Application will be made at the next session of Parliament to confirm a trackage agreement between the Canadian Southern Railway, the Michigan Central, and the Pere Marquette Railway, and to empower the Canada Southern Railway to acquire the Sarnia, Chatham, and Erie Railway, and the Leamington and St. Clair Railway.

Additions to the Grand Trunk repair shops, at Stratford, Ont., are contemplated, which will make room for 400 more men.

Stratford, Ont., has two radial electric railway projects; from N. M. Cantin, for a line to St. Joseph, on Lake Huron, via Avonton, Carlingford, Fullarton Corners, Russeldale, Cromarty, Chiselhurst, Hensall, and Zurich. Also from H. M. Sloan, Chicago, for a line to take in Sebringville, Mitchell and St. Mary's.

Charles H. Fisk has asked Detroit for a franchise to build a tunnel across the Detroit river. It is proposed to use the McBear system of building through the river by dredging out the course for the tunnel and constructing it therein.

The Grand Trunk have erected a new coal shute in Toronto, known as the Fairbank-Morse machine, of Chicago. It has two pockets, one on each side of the building, capable of holding 250 tons of coal each, and locomotives can be loaded in thirty seconds. It will do the work of twelve men.

Chrysler & Bethune, Ottawa, for the Central Ontario Counties Railway, are applying for a charter to construct a railway from Ivanhoe, Ont., to Agincourt, Ont. A. B. Colville, Campbellford, Ont., for the Campbellford, Lake Ontario and Western Railway, is also applying for a railway from a point on the C.P.R., between Blairton and Ivanhoe, to a point on the C.P.R. bewteen Locust Hill and Leaside Junction, Ont. Either of these lines would materially decrease the distance between Toronto and Ottawa.

The New York Central has introduced a new passenger engine styled the Pacific type, which differs in many respects from the Central Atlantic type. Instead of two drive wheels the Pacific has three. The tank has a capacity of over 6,000 gallons. In the trial trips these engines have displayed excellent speed, they possess enormous hauling power, and, it is said, will excel the reputation of the Central Atlantic. They will do service on the main line fast trains.

The following applications are to be made to the Ontario Legislature: The Toronto Suburban Railway for power to extend through Hamilton, the Counties of Wentworth, Lincoln and Welland, to Niagara Falls, also to Woodbridge and Brampton. To construct branch lines, etc. The Schomberg and Aurora Railway for an extension of time, and that King Township be empowered to pay a bonus. The Strathroy and Western Counties Railway for power to extend through St. Thomas to Port Stanley, Ont. The Hamilton, Beamsville, and Grimsby Railway to confirm a by-law to build branches and establish parks. J. H. Coburn, Walkerville, for an electric railway charter from Windsor, via Walkerville, to Chatham. The Sandwich, Windsor and Amherstburg Railway, to confirm a bond issue of $600,000, and power to take over the Windsor system. The Brantford and Erie Railway for a charter to build a line from Brantford, via Waterford and Simcoe, to Port Dover, with a loop line from Waterford, via Delhi and Lynedoch, to Simcoe.

It is proposed to found a school of railroad engineering and transportation in connection with McGill University, Montreal. The C.P.R. and G.T.R. will grant an annual subsidy of $3,000 each, while the Canadian Northern will contribute $2,000 yearly and negotiations are in progress with other roads, including the Intercolonial. It is believed to be possible to secure $20,000 annually for maintaining the school, and it is anticipated that the railroads will afford facilities which will enable students to undertake practical work, under supervision, concurrently with the theoretical teaching at the university. The drawing up of a scheme of studies has been entrusted to a committee which includes Mr. Morse, of the G.T.R., and Mr. McHenry, chief engineer of the C.P.R. The syllabus will include: (1) Location, including all branches of surveying. (2) Construction, including the laying out of work, the construction of bridges, buildings, etc., track laying and ballasting, organization, specifications, etc. (3) Operation, including: (a) Maintenance of way and structures; (b) the conducting of transportation; (c) equipment, organization, legislation, etc. It is expected that work in the new department will be commenced in September.

LIGHT, HEAT, POWER, ETC.

Work on the power scheme at Koochiching Falls, Rainy River, will be started at once.

Edmonton, N.W.T., has granted a franchise to a company for whom N. D. Beck is acting, for the production of natural gas.

A fall of ice on January 18th damaged the Niagara Falls Hydraulic Power and Mfg. Co.'s power house, shutting down four generators.

Ada Parker, whose son was killed by a live wire in Ottawa, on May 21st last, has obtained $500 damages from the Ottawa Electric Light Co.

The Sherbrooke, Que., Heat, Light and Power Co. has agreed to accept the city's offer of $200,000 for the electric plant, if the latter will purchase the gas works.

T. Wilson, said to be acting for J. J. Hill, has obtained controlling interest in the Stave Lake Power Company to supply power to a new line from Westminster to Vancouver.

It is stated that the Electrical Development Co., of Ontario, and the Toronto-Niagara Power Co. have purchased 85 per cent. of right of way eighty feet wide, between Niagara and Toronto.

A charter is to be applied for with power to construct, on the Roseau river and elsewhere in Manitoba, water and other power, and to construct an electric railway line within seventy-five miles of Emerson, Man.

J. M. Campbell, of the Gananoque Electric Light Co., and the Kingston Milling Co., has purchased the old mill, at Kingston Mills. He will build a power house and develop the electrical power to run his mill in Kingston, Ont.

The C.P.R. is contemplating the use of electricity in their elevators at Fort William and Port Arthur. The plant will be at Fort William, and sufficient power generated to supply the elevators at Port Arthur. The cost is estimated at $500,000.

Electricity promises to be an important factor in the Rossland, B.C., mining industry. The West Kootenay Power and Light Co., and the Rossland Power Co., are supplying a rapidly increasing amount of power. The cost is 50 to 60 per cent. of that in the Pacific North-West mines.

In the case of the city of Ottawa v. the Ottawa Electric Co., Judge Ferguson has dismissed the motion. The case in dispute was as to the right of the Consumers' Electric Co. to use certain poles of the Ottawa Electric Co. for the purpose of stringing wires, and this decision gives the former company that right.

The Vancouver Power Company completed the big dam on Lake Beautiful last month. It is 360 feet long, 50 feet deep, and 40 feet wide at the bottom, tapering to ten feet at the top. It is built on solid concrete, with a foundation on the mountain rock. When the tunnel connecting Lakes Beautiful and Coquitlam is completed, 30,000-h.p. will be available.

Major VanBuskirk, city engineer, Rossland, B.C., is preparing estimates for a civic lighting plant capable of supplying 7,000 to 10,000 inhabitants. Notice will be given the Rossland Water and Light Company that the city purposes taking over their system at the expiration of the contract.

Westinghouse gas engines will be installed in the new Central Station, at Berlin, Ont. The initial installation will aggregate 460-h.p., comprising three 13 by 14 three-cylinder, 125-h.p., and one 11-in. by 12-in. three-cylinder, 85-h.p. vertical engines. These engines will operate on city illuminating gas of 650 B.T.U. calorific value, and drive direct-current generators for furnishing municipal lighting.

The Shawinigan Water and Power Company has completed the transmission line to Sorel, Que. A transformer station, at Joliette, reduces the 50,000 volt current to 12,500 volts, which is transmitted across the St. Lawrence river, near Lanoraie, by a heavily insulated submarine cable. The circuits are of aluminum throughout, made by the Northern Aluminum Company, at Shawinigan Falls. Power is to be supplied to other points between the Falls and Montreal.

TELEPHONE AND TELEGRAPH.

North Monaghan is now connected by "Bell" telephone with Peterboro.

Regina, N.W.T., will soon have "Bell" long distance connection with Winnipeg.

An effort is being made to establish a telephone service at Channel, Newfoundland.

A telegraph line is to be constructed from Edmonton, N.W.T., to Athabasca Landing.

A telephone cable has been laid across the river from a point on the Strait Shore to Market Slip, in Carleton, N.B., a distance of 1,200 feet.

The Immigration Department announced recently that the telegraph line from near Fort Pitt to Barr Colony would be completed by January 20th.

The C.P.R., under the terms of their agreement with the N. B. Telephone Co., has refused connection to the Union Telephone Co., at Woodstock, N.B. The matter is to be brought before the Railway Commission.

The automatic telephone system of the Citizens' Telephone Company, of Grand Rapids, Mich., was put in operation on January 9th, with 5,300 phones attached to it. This is the largest exchange in the world operated without girls.

The Canadian Machine Telephone Co., owners of the patent rights in Canada of the "Lorimer" automatic telephone exchange, will shortly open their new factory on Duncan street, Toronto. Most of their staff have already arrived from Ottawa.

The Southern Telephone Company has purchased the Western Union Company's line between the coal pier, Sydney, C.B., and Centreville. The telegraph company had to abandon this line on account of the tramway interfering with the working of it.

A case of interest to municipalities was decided recently by Judge Chisholm, at Galt, Ont. The Bell Telephone Co.'s assessment was raised from $2,200 to $6,000, and the company contested. The company had 445 poles in Galt, with 652 cross arms, 4,480 feet, 25 pair cable, and 1,920 feet, 50 pair cable, and 86 miles of wire; seven 50 line switchboards and about 350 telephones in use. Expert testimony valued each pole and its cross-arms at $11.50. The judge decided the assessment was too low and raised it to $4,999.50.

NEW CATALOGUES.

Copies of these may be had on writing any of the firms named, mentioning the Canadian Engineer:

The Sunbeam Incandescent Lamp Co., of Canada, McKinnon Building, Toronto. Standard miniature and decorative incandescent lamps.——The Jeffrey Manufacturing Co., Columbus, Ohio. Catalogue, No. 52, "Jeffrey Coal-Washing Machinery," "Jeffrey Machinery" for sawmill, lumber, and wood-working industries. Also Jeffrey screening machinery.——The Westinghouse Electric and Mfg Co., Pittsburg, Pa. No. 1,032, the "Westinghouse No. 56 Railway Motor Motor;" No. 1,059, "Electric Motor-Vehicle Equipments," and No. 1,066, "Type H. Induction Motors."——The Brown & Sharpe Mfg. Co., Providence, R.I. Mechanical machinists' tools.——The J. Stevens' Arms and Tool Co., Chicopee Falls, Mass. Rifles, pistols and shotguns.——Goudey-McLean Co., New York. Bulletins No. 10, "Type A, Generators and Motors;" 17, "Type B, Belted Generators;" and 18, "Type C, Engine Type Generators."——The Armstrong Bros. Tool Co., Chicago. "Armstrong Tool Holders."——The Chicago Pneumatic Tool Co., Chicago. Pneumatic drills, hammers, hoists, etc. The Buffalo Steam Pump Co., Buffalo, N.Y. Fire and boiler feed pumps.——The Diamond Saw and Stamping Works, Buffalo, N.Y. Sterling hack saws.——James Cooper, Montreal. Scrapers, wheel-barrows, hoisting buckets, diaphragm pumps, etc.——The Buffalo Forge Co., Buffalo, N.Y. A series of bulletins: "A Compound Engine Test," "Buffalo B. Volume Blowers and Exhausters," "Buffalo Improved Ventilator."——The B. Greening Wire Co., Limited, Hamilton, Ont. "Wire, its Manufacture, Antiquity and Relation to Modern Uses."——The Canadian General Electric Co., [illegible] "About Track-Cleaning Devices," the "Thompson [illegible] Forge Induction Wattmeter."——Belt Engineering [illegible] Philadelphia. "Link-Belt Case-Hardened Sprocket W[illegible]——The Carborundum Co., Niagara Falls, N.Y. Carborundum wheels, sharpening stones, etc.——James McCrea & Co., Chicago. Steam specialties, joint clamps, steam traps, drilling and boring machines.——The Bignall & Keeler Mfg Co., Edwardsville, Ill. Pipe threading and cutting machinery.——The A. S. Cameron Steam Pump Works, New York. Illustrated pamphlet of steam pumps.——The Erie City Iron Works, Erie, Pa. "Erie City Water Tube Boilers."——The United Telperage Co., New York. Circulars No. 37, "Cable Lines;" 38, "Automatic Telpher Plants," and 42, "Reserve Coal Storage."——The Bradford Machine Tool Co., Cincinnati, Ohio. "Bradford Lathes."——The Hyatt Roller Bearing Co., Harrison, N.J. Bulletin No. 20, "Hyatt Flexible Roller Bearing as applied to Heavy Duty at Slow Speed."——The Power and Mining Machinery Co., New York. "Gas for Furnace Work," also "Gas Engines."——The Rotary Engine Co., Philadelphia. Direct power generating belts.——American Steam Pump Co., Battle Creek, Michigan. Marsh boiler feed pumps.——The Atlas Car and Mfg. Co., Cleveland, Ohio. Catalogue No. 1,018, Mine and ore cars, dump cars for smelting and roasting plants, etc.——Holden & Brooke, Limited, Manchester, Eng. Catalogue C, Steam plant specialties, injectors, ejectors, and feed water heaters, water and oil separators, etc.——The David Bell Engineering Works, Buffalo, N.Y. "Bell Steam Hammers."——The C. W. Hunt Co., New York. Mine hoisting equipments, automatic, industrial and cable railways; conveyors and locomotives.——Queen & Co., Incorporated, Philadelphia. Optical and scientific apparatus.——The Cling-Surface Mfg. Co., Buffalo, N.Y. "Cling-Surface and Belt Management," by J. E. Powers, M.A.——The Crocker-Wheeler Co., Ampere, N.J. "The Mechanical Equipment of the Orange Brewery, N.J.

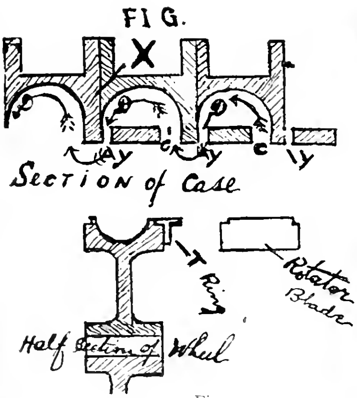
Calendars have also been received from the undermentioned firms, and are acknowledged, with thanks: The Alexander Engraving Co.——The Smooth-On Mfg. Co.——The Intercolonial Railway.——The Quebec and Lake St. John Railway.——The Knoxville Engraving Co., Knoxville, Tenn.——The Standard Tool Co., Cleveland.——The American Steam Gauge and Valve Mfg. Co., Boston, Mass.——The News and Eastern Townships' Advocate, St. Johns, Que.

THE MACCOLLUM STEAM TURBINE.

Having described the Parsons and the Curtis and other types of steam turbines, we now describe one of Canadian origin, viz., the MacCollum Steam Turbine, invented by J. H. K. MacCollum, of Toronto. The illustrations show the principal parts of the experimental machine built by the Dominion Motor and Machine Co., Toronto, lately. This turbine consists of a series of wheels forming the rotating member, mounted on a tool steel shaft (Fig. 1, Z), each wheel being identical with the other, consisting of a hub and web, carrying a rim with parallel edges, the face of the rim being turned out in the form of a semi circle, seventy five slots being milled on the face at a tangent with the bottom of the groove; into these slots sheet brass strips are driven [illegible] the edges then have a portion turned out of each side, [illegible] a steel T shaped ring fitted to anchor in the blades. Bronze rings were tried first, but they expanded by centrifugal force due to the high speed, and had to be replaced by the steel ones. After the wheels are finished and put on the shaft, a collar is screwed up against one end, [illegible] fixed collar being at the other), which presses all the wheels together sufficiently tight to prevent them moving, the first and last wheels having feathers in them to assist the collars in securing them to the shaft. A special plate was put on each [illegible] The stationary member, or case of the turbine, is shown at Fig. 2, and consists of a series of rings; section [illegible] which is shown in Fig. X; the nozzles are shown at Y in [illegible] X and 2. The first ring of the case (not shown [illegible] cut), is arranged to go between the end plate Fig. 3, and the

second ring (shown at A). It simply forms a steam belt, to supply steam freely to the series of nozzles around the ring extending into the steam belt, as shown at B. The steam passing through the nozzles, Y, enters the bucket at the edge, and as the bucket has an oval section, due to blades being inserted in the curve at a tangent, the steam is completely reversed in the first wheel. It discharges from the first wheel into the slot, C, formed by the nozzle ring of one case being separated from the next case, as shown at C, Fig. X, and 2, and as the steam enters the case it is again reversed in direction by the curve in the case. The direction of the current of steam is in the direction of rotation, and also longitudinally. The nozzles are drilled at a similar tangent to the bucket blades, and as the steam turns the outer case it meets the extending ring containing the nozzles for the next wheel, as shown at D Fig. X; it passes through these as before, and so on through the entire length of the machine into the exhaust end case at E, and out through the opening F into the condenser.

The case is shown up at an angle of 90 degrees from its position, when in place, to show the row of openings that were arranged for drips, and also to connect gauges to, but it was found on testing the machine that it would clear itself of water without using the drips, so they were only used for the gauges, one of which was attached to each case to show the drop in pressure from one end to the other. The end cover, with foot attached, shown at Fig. 3, carries the case on the ring at G, and the bearings shown at H. The bearing consists of a cast iron shell bolted to the cover, and bored out to secure a bronze shell a few thousandths smaller than the bore. In this shell is fitted another which carries the shaft. The outer shell is adjusted to bring the shaft



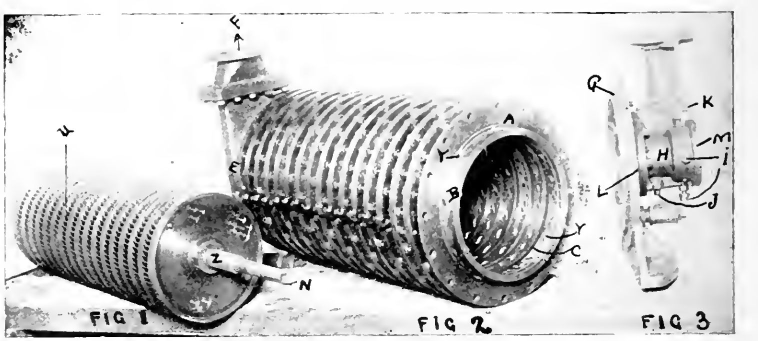


Fig. 1.

centred by the screw shown at I. Oil is forced in under pressure at J. and escapes at K, being prevented from entering the turbine by a set of metallic packing rings between the corner plate and bearing case at L. On a flange shown at M. on the opposite or exhaust end was attached a thrust bearing (not shown), to take up the end thrust which was very great, due to steam being on one end and a vacuum on the other. The entire machine was mounted on a cast iron base, the pulley for the Prony brake being mounted on a separate shaft between a special pair of bearings. The power was transmitted through a square sleeve between the rotating shaft and the pulley shaft; the end of the rotating shaft is shown square at N Fig. 1, where sleeve is slipped out.

A series of tests was conducted and experiments made to determine the value of certain changes, and after getting away from some thrust-bearing troubles, the average tests showed approximately 20 lbs. of water per horse-power per hour. The first test was rather disappointing, as about 7-h.p. was the best obtained, but after two changes they obtained 47-h.p. This is exceptionally good, as the highest pressure obtainable was 100 lbs., whereas the machine should have had 150 lbs. with a considerable degree of superheat. The vacuum was very poor also, but sufficient information was obtained to warrant the Bertram Engine Works taking up the patent for Canada, and we understand they are preparing to build an improved machine that is expected to get below 14 lbs. per horse-power per hour. The type of machine, as built, shows the MacCollum turbine to be almost indestructible; the rotator can be taken out and rolled on the floor without injuring it, whereas other machines have to be handled with the greatest care and with special slings. The leakage between the cases and the wheels was not very material, although it reduced the economy, no doubt.

LITERARY NOTES.

"The Mechanical Engineer's Reference Book," by Henry Harrison Suplee, B.Sc., M.E.; 801 pages; published by the J. B. Lippincott Co., Philadelphia, at $5 net; with patent thumb index, $5.50. This work, which is the result of years of careful work on the part of the author, is a valuable book of reference on engineering matters, and should be in the hands of every engineer, student, and draftsman. 228 pages are devoted to mathematics, 48 to mechanics, 135 to engineering material, 65 to machine design, 111 to heat, air, water, fuel and steam, 107 to steam boilers, engines, and internal-combustion motors, and 82 to electric power and the cost of water, steam, gas and electric power. Very comprehensive and valuable data are given upon each subject, with useful diagrams and drawings. The concluding pages are devoted to works' management, and an appendix is added comprising data regarding aluminum, locomotives, the powering of steamships, conversion of horse-power into kilowatt and unit equivalents for electric-heating problems. In view of the fact that the metric system is being discussed, a number of tables, in both British and metric units, are presented, so that engineers may use the latter system if desired. Among these may be mentioned metric steam tables for steam computations.

"The Factory Manager and Accountant," by Horace L. Arnold; 432 pages, six by nine; published by the Engineering Magazine, New York, at $5. This book contains some examples of the latest American factory practice, and is made up of several complete systems of factory-accounting forms, the costing and commercial blanks being accurately reproduced. The function and manner of using each form are carefully detailed, so that the reader can make an intelligent estimate of its value, if applied to his own uses. The systems in vogue at several of the most successful factories in the United States are fully explained and illustrated. Factory managers will find in this book many hints and examples of the greatest value in arriving at a satisfactory system of cost-finding and other methods of accounting essential to successful management.

"Machine Design," Part 2, third edition; by Forrest R. Jones, Professor of Machine Design, Cornell University; 426 pages, 6½ by 9½; published by John Wiley & Sons, New York, at $3. This book treats of many subjects of importance to the designer, including bearings and lubrication; spur and friction gears; belts, ropes, and screws for power transmission; screw gearing and fastenings, shafting, shaft and friction couplings, and brakes; fly-wheels and pulleys, and cylinders. The data have been gathered from numerous sources during the last fifteen years, and the equations and

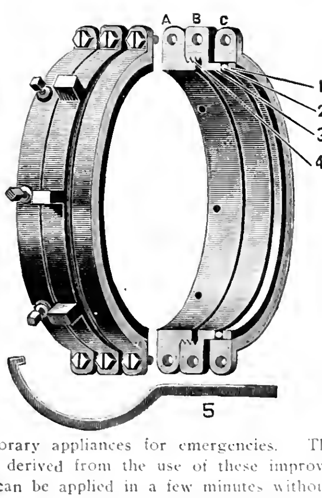
formulas are in such form as to afford a ready means of application. Numerous examples from practice, representing the experience of engineers, are given in preference to abstract statements, thereby affording the reader a better means of studying the facts incidental to any particular case. Much new data relating to roller and ball bearings, not contained in the preceding edition is included; 32 pages and 23 new figures are devoted to these subjects. Throughout the book new problems have been added and revision made to bring this work up to the most recent practice.

"Steam Boilers, Their Theory and Design," by H. de B. Parsons, B.S., M.E.; 367 pages, 6½ by 9½; published by Longmans, Green & Co., New York, at $4. This work is a series of lectures delivered to the senior class of the Rensselaer Polytechnic Institute, Troy, N.Y., and while the author makes no claim to originality, his object has been to cover such points as in practical office work may be perplexing. The book covers the field of boiler making and operation in a comprehensive manner, the subjects treated including physical properties, combustion, fuels, materials, boiler details, mechanical stokers, artificial draft, incrustation, corrosion, explosions, smoke prevention, testing and the care of boilers. It is well illustrated and will be found a useful work in the hands of the designer, steam engineer, and student.

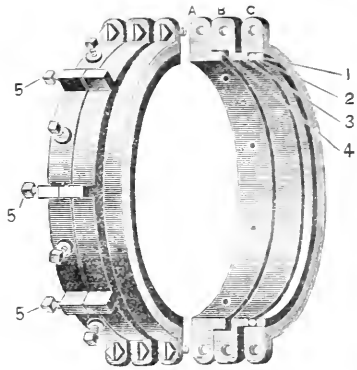
The Electric Club Journal is the title of a new illustrated monthly magazine, published by the Electric Club, Pittsburg, Pa., the members of which comprise the officers and employees of the Westinghouse Electric Mfg. Co. The first number will appear this month, and its immediate purpose is to put into permanent form the engineering papers and technical discussions of The Electric Club. Many of the papers will be written by the engineering staff of a leading electric company, and much of the material will pertain to the latest apparatus and to the newest problems in engineering work. This matter will be published in a form suited to the needs of intelligent young men. The circulation is not restricted to the members of the club, but the privilege of subscribing is extended to others. Subscriptions, $1 per annum, to be forwarded to the Electric Club Journal, Box 911, Pittsburg, Pa.

THE "CLIMAX" STEAM CLAMP.

James McCrea & Co., steam specialty manufacturers, Chicago, who for the past six years have devoted much attention to leak-closing clamps, have placed on the market a perfected clamp which embodies the benefits of their experience and eliminates all the difficulties found in former home-



made temporary appliances for emergencies. The advantages to be derived from the use of these improved clamps [illegible]: They can be applied in a few minutes without shutting [illegible] or shutting off steam, and will effectually stop the leak, [illegible]aving the expense of pulling down and renewing the [illegible] make a permanent repair job, which never wears [illegible]ing being replaced as readily as on any other pipe, and save many times their cost every month. They are made in all sizes, and two [illegible] to tighten with a right and left connection w[illegible], and No. 2 by set screws. They are practically [illegible], combining lightness with good service. In the [illegible], Fig. 1, showing the spanner design, A is a rigid clamp [illegible] male thread, held firmly to the pipe with set screws; [illegible] a loose clamp with female thread and lugs for the spanner, which screwed away from A forces with blank face packing through clamp C to joint; C is a loose clamp holding [illegible]



ing 1, and follows ring 2. In Fig 2 ring B is forced [illegible] screws 5, 5, 5. The clamps are made in [illegible] together, enabling rapid adjustment [illegible] pipe. All steam engineers realize the importance [illegible] able to repair a leak, without shutting down, which in some case would entail the loss of thousands of dollars, therefore the importance of such an appliance as the "Climax" clamp, especially in high pressure plants, should be readily appreciated. The makers will be pleased to furnish further information regarding this cheap and efficient means of effecting speedy repairs, on application.

TORONTO BRANCH AM. INSTITUTE OF ELECTRICAL ENGINEERS.

The Toronto branch of "the American Institute of Electrical Engineers" was organized in May, 1903, and since then have been holding monthly meetings in the rooms of the Engineers' Club. The papers discussed by the parent Institute usually form the subjects for discussion at the meetings of the Toronto branch, but a number of papers by local members, of subjects peculiarly interesting to Toronto and vicinity have been brought out and have proved extremely interesting. From an initial membership of thirteen, the branch has grown to thirty-eight members. Their next meeting will be held at the Engineers' Club, Friday, February 12th, when "Transformers" will be one of the subjects for discussion. The officers of the Toronto branch are: J. A. Kammerer, chairman; Prof. Rosebrugh, vice-chairman; R. T. Mackeen, secretary-treasurer; W. C. Hawkins, James Kynoch, T. R. Rosebrugh, executive committee.

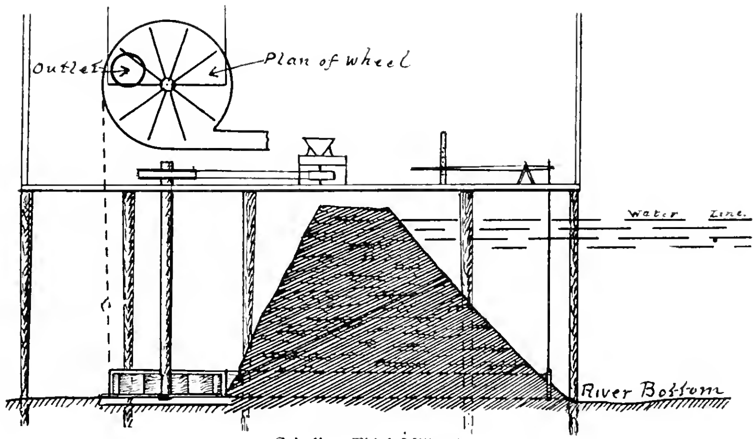
TIDAL MILL.

Editor, Canadian Engineer:—

Sir,—Conforming to your wish for a sketch of an old tidal mill, which I referred to in the December issue, under "Power from the Tides," I beg to hand you the enclosed, which is a reconstruction from remains in sight and the memories of the older residents of the localities. These mills must have possessed considerable power, for they ground all the grain of the community, including the wheat, and this particular one had near it a dry house, where oats were first dried and then made into oatmeal, or "groats," and where human nature, ever true to itself, instinctively assembled the primitive bad boys of the grocery, who filched to the capacity of yawning pockets, the sweet, nut-flavored oat grains. I measured the old stones. They were four feet in diameter and many one foot thick, of granite, and were of

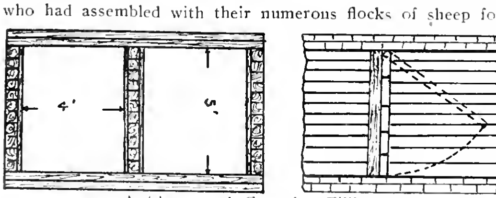
course set horizontally, the product of the grinding being thrown off by centrifugal force. The motor was made entirely of wood. The vanes were horizontal, and the shaft upright. The former were made of deal, and mortised directly into the latter, which was about twelve to fourteen inches in diameter, and carried on its upper end a large wooden pulley with a belt running directly to the mill stone spindle which was of iron. The diameter of these motors must have been from six to ten feet, and they must also have developed considerable power, for they performed no mean amount of work; the stones were heavy, and of course required quite a high velocity to create the centrifugal force. The old mills, tidal and otherwise, which were built for sawing logs, were of a different construction. The motor was an undershot wheel ten to twelve feet long, and about four in diameter, the floats of deal, with a crank at the end of the shaft which gave the vertical reciprocating motion to the saw frame above. When it was necessary to run back the log carriage or draw a log into the mill, they resorted to no reversing gear, for one or two small flumes opened from the main, each with an upright shaft and wheel of small diameter having wooden cogs on the upper end, which geared into similar ones on the side of the log carriage. This primitive method was not without its advantages, for the motors could be built in a short time, and of a semi-circle could be constructed anywhere, and the ingress sluices with gates opening inwardly only must conform in capacity to the area inside the dam. These old pioneers were not lacking in boldness of conception, for the grinding mill of which I speak was not fully filled by the sluices, but its top was several feet below high water, so it simply poured over and the ebb tide left it full to the brim. These mills must have been built about 1820, and been in operation forty years or more. As to the oldest, I can give no information. Probably they would date to 1800.

Office of County Engineer, Canning N.S. — WM. RAND.



Grinding Tidal Mill, 1825.

power could be applied at any point independently of the others. I remember my first impressions of one of the latest, or possibly the last, of these old mills. I was awed by its multiplicity of levers, and unnumbered pin holes in wooden uprights, between any two of which the long end of the levers were confined, while the miller, inflated with responsibility and importance, strided now here, now there, hurling numerous orders at his single assistant, taking respite only to project an oath down the tail race at farmers who had assembled with their numerous flocks of sheep for



A Sluice and Gate for Filling.

their yearly washing before shearing; and who had by their demand in unparliamentary language for more water from the sluice gates, roused the miller's wrath.

The tidal dams were built wholly of the alluvial mud or clay. The tendency was to split in a heavy dam, so the structure was filled with small trees, which tied it together care being taken that none extended through and made a leak. These dams could be made in any position required, that is, directly across a river at any point, or at the mouth of a creek which emptied into a river, or a dam in the form

PERSONAL.

Capt. J. C. Ferris has been appointed harbor-master of St. John, N.B.

James Menzies succeeds the late Thomas Weeks as superintendent of the Sydney, C.B., waterworks.

H. J. Saunders, deputy commissioner of public works in the N.W.T., has resigned, to join Mr. Dennis, late of the C.P.R., to carry on work as civil engineers, with headquarters at Edmonton.

A. E. Ames has resigned the chairmanship of the Temiskaming Railway Commission, and is succeeded by Robt. Jaffray.

Thomas Cantley succeeds Graham Fraser, as managing director of the Nova Scotia Coal and Steel Co., at Sydney Mines, C.B.

Hamilton Ruddick, mechanical and electrical consulting engineer, a native of St. John, N.B., died in New York on January 7th.

F. T. Jennings, formerly chief operator and circuit manager of the C.P.P. Telegraphs, has been appointed inspector of telegraphy of the Eastern division. H. Bott is promoted to Mr. Jennings' former position.

R. W. Douglas, who was well known in Quebec, when secretary of the Shawinigan Water and Power Co., has been appointed secretary of the Lumber Trade Club of Boston.

Luke Robinson has resigned the position of superintendent of the Montreal Street Railway.

W. T. Jennings, C.E., was offered a seat on the municipal power commission, with position of consulting engineer. Mr. Jennings could not accept, owing to prior engagements, which would conflict, but he assisted the commission in obtaining a suitable member.

Thomas Fraser, one of the oldest shipbuilders in Nova Scotia, died recently. The deceased had four sons: Graham, general manager of the Dominion Steel Co.; Simon A., w[illegible] at the time of his death was manager of the Nova S[illegible] Steel and Coal Co.; James, connected with the N.S[illegible] Co.'s works, at Wabana, and John W., superinte[illegible] smelting works, Trenton.

S. Coulson, vice-president and general manager of H. R. Ives & Co., Montreal, died suddenly in Toronto on Jan. 4th, from heart trouble. Deceased was connected with the firm of Coulson, Quinlan & Robinson, who have secured a million dollar contract for repairs on the Lachine Canal, and was regarded as one of Montreal's prominent business men.

Elijah E. Abbott, Gananoque, Ont., died on January 8th, aged 77. Deceased was born in Connecticut. On coming to Canada he joined his brother, D. S. Abbott, who established the Globe Works, Gananoque. On the latter's death, Elijah acquired the machine shop, which he ran for several years. Afterwards he built the factory on the west side of the river, now owned by the Gillies Co. About fifteen years ago he sold out to a company. Mrs. Abbott, four sons and one daughter, survive him.

D. Nicoll is now vice-president and general manager of the C.P.R. and William Whyte, of Winnipeg, Man., second vice-president, and manager of the lines west of Lake Superior. Mr. Whyte is a Scotchman, and began railway life in the North British Railway, coming to Canada in 1863 and entering the G.T.R. Subsequently he became manager of the Toronto, Grey and Bruce, now part of the C.P.R., Ontario and Quebec division. In 1897 he was appointed manager of the lines west of Fort William, and two years ago assistant to Sir Thomas Shaughnessy.

N. S. Braden, formerly manager of the Westinghouse Electric and Manufacturing Co.'s district office, at Cleveland, Ohio, has succeeded the late Thomas C. Frenyear, as sales manager of the Canadian Westinghouse Co., his headquarters being at Hamilton, Ont. Mr. Braden was born at Indianapolis, Ind., thirty-four years ago, and entered the Jenny Electric Motor Co. in that city in 1892, remaining there until 1899, when he joined the Cleveland district sales office of the Westinghouse Electric and Manufacturing Company, as a salesman, subsequently becoming manager.

Sir William Allan, marine engineer, ship owner and member of Parliament for Gateshead, Eng., died last month, aged 67 years. He was well known as an engineer, was chairman of the Albyn line, and a director of Richardsons, Westgarth & Co., Limited. He was born at Dundee, and of his education often said: "The world has been my chief educator, and men my books." Sir William was chief engineer on a blockade-runner during the American Civil War, and was captured and lodged in the Old Capitol Prison, but was released on parole. For fifteen years he managed the North-Eastern Marine Engineer Co., and was proprietor of the Scotia Engine Works in Sunderland.

MUNICIPAL WORKS, ETC.

Stratford, Ont., proposes to spend $70,000 for permanent asphalt block roadways.

St. John's, Newfoundland, is applying to the Government for a grant of $100,000 to improve the water supply.

The Maritime Contracting and Mining Co., Charlottetown, P.E.I., are constructing a gravitation water system, at Springhill, N.S.

Toronto is investigating the Edson system of garbage disposal with a view to installing a plant. The purchase of an asphalt plant is also contemplated.

Justice Davidson has granted an interlocutory injunction to prevent the city of Montreal working the McTavish street reservoir electric pump, owing to the noise and vibration caused by its operation.

What is claimed to be the first solid cement bridge in Ontario has been erected over a creek, near Tavistock. The span is 30 feet with no support between the abutments, which are 3½ feet at the base and 2½ feet at the top. The flooring is 14 inches thick. Cost, $635.

The new cantilever bridge, across the Strait of Canso, will have the longest span in the world, being 1,800 feet. Its total length will be 3,300 feet. Estimated cost, $5,000,000. The Dominion Iron and Steel Co. will supply 35,000 tons of steel for its construction. Waddell & Herrick prepared the plans.

SAVING TIME IN THE DRAFTING ROOM.

BY [illegible] W. SALMON, C.E.

The man who sits on a high stool before a big table and looks serious a number of hours a day, and very oft sharpens his pencil, is not always the man who gets out the most drawings or the best. This was very forcibly impressed on the writer's mind some time ago where there were several changes in the office force, and amongst the new comers there was one man who told us all of his long and varied experience in every line of work which, as the writer remembers correctly, included air ships and various devices in the use of radium, and of course all such common things as battle ships, dynamos, electric travelling cranes, blast furnaces, gas engines and racing yachts had been constructed in various parts of the world for all the great millionaires, by this young man whose beard was quite short.

Of course we learned the history of this young man by degrees, but we were all very much impressed by the very complete kit of tools that he carried, which was certainly very attractive and seemed to cover about everything that a man could expect to use in a drafting room, and as chance would have it, this young man was put on the same table beside the middle-aged man who did not seem to have anything, and who was continually borrowing everything (except a two-foot rule), from his neighbor. Nevertheless the man without the tools was busy all the time and did get the drawings and tracings made.

Now the particular incident that I think will prove interesting to the reader happened shortly after dinner, before the engineer had returned, the chief draftsman having come in, looked around very seriously and seeing that everybody was busy left the office, when our young friend with the large box of tools started out to borrow an oil can to oil the small screws on his bow-pen-compasses, which he had said had got dry and were sticking. He had been doing more or less cussing all the forenoon about the "bum-office, without an oil can," and so he went around from one to another telling us all what a beautiful silver plated bicycle oil can had been given him in some town, the name of which I don't remember, which he always carried with him full of a special grade of watch oil, but which he had not thought to bring down to this office, and that he just wanted to borrow ours for a few minutes. Now the chief draftsman always scolds everybody unmercifully that produces a tracing in which the lines appear to have been made on greasy cloth, so we are all desperately afraid of everything greasy, and for that reason used to wear high white collars and long white cuffs, and keep a long way from everything that looked like machinery, so nobody had an oil can, and our young friend with the large number of small tools commenced his second pilgrimage around the office, telling every one of us what a miserable, poor, shiftless, worthless, good-for-nothing, bad, bad, bum-office ours was, because it did not have an oil can. After this had been gone through with, our friend without any tools, called the other man over and asked him what was the matter, and what he wanted, and after receiving the explanation he told him he would fix his instruments, so our young friend seemed to at once jump at the conclusion that he would now get repaid for all the lending that he had done. So taking all the small tools over to the other man, he watched him rub the point of a soft black lead pencil on the screw of each instrument and then run it back and forth, when it appeared to be better lubricated that it would have been with oil, and since that time we have always taught the new-comers to rub a soft pencil on the screws of their instrument with very satisfactory results

C. E. Brown, recently assistant works manager of the Canadian General Electric Works, Peterboro, Ont., was the recipient of a dress suit case, presented by the employees, on his retiring from the company to accept a position on the Government Commission, appointed to investigate electrical smelting in Europe.

MARINE NEWS.

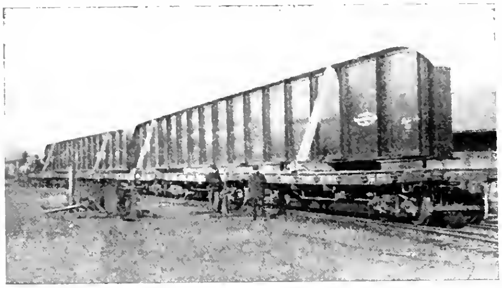
It is proposed to construct a deep ship canal between Lake St. John and Lake Erie.

Across the Missouri river, near St. Joseph, is a ferry run by the river's current. A steel cable is passed across the stream over the boat, and this cable passes through two stationary pulleys on the deck. The boat is held so that the current strikes it at an angle of about 45 degrees, and forces it across the channel. It carries 100 tons of cargo over in four minutes.

The Polson Iron Works, Toronto, is building a composite, double-ended steam ferry boat for passengers, horses and wagons for the Burrard Inlet service of the North Vancouver Ferry Co., B.C. The steel work will be fitted up in Toronto, taken down and re-erected at Vancouver, where it will be riveted up and the work completed. The dimensions are: Length, 148 ft.; beam, 28 ft.; draught, 6 ft. 2 in., with a capacity for twelve double teams and 600 passengers. The engines will be fore-and-aft compound, having cylinders 14 and 28 in. diameter by 20 in. stroke, and two Scotch boilers, 7½ ft. diameter by 10 ft. long, built for a working pressure of 150 pounds. The same firm is also constructing a fast river barge for the Roman Catholic mission in the Peace river district. She is 80 ft. long, 15 ft. beam and 5 ft. draught, having fore-and-aft compound engines, equipped with a Fitzgibbon boiler. The steel work will be fitted complete in Toronto, and re-erected and completed at its destination.

LARGE GIRDERS.

The accompanying engraving illustrates two heavy girders recently shipped by the Hamilton Bridge Works Co., to the Intercolonial Railway, at Levis, Que., where they will be used for Government street crossing about one mile east of that city. As will be seen, these girders take up the entire space of six cars four of them being 60,000 lbs'. capacity each. The length over all of each girder is 112 ft. and the depth 9½ ft., and the weight of one girder only is 79,000 lbs. or the total weight of the span when put in position will be 266,000 lbs. This is the heaviest plate girder span ever built in Ontario, and has been seldom exceeded in the United States. This bridge is being erected at the point above mentioned under the supervision of W. B. McKenzie, chief engineer of the Intercolonial Railway, and the structure was designed under the supervision of C. G. Milne, chief engineer of the Hamilton Bridge Works Co. It is built as one of the eleven which the company is now erecting on the line of the Intercolonial Railway.



Four new turbines of 6,000-h.p. each have been ordered from a German firm by the Cataract Power Co., of Hamilton, for installation in their power station at De Cew's Falls. These turbines are of the inward discharge type with horizontal shaft.

The Ontario Power Co., whose electrical developments at Niagara Falls are progressing, has let the contract for three turbines of over 11,000-h.p. each. The contract went to a German firm. These turbines are of the inward discharge type with horizontal shaft, and will be the largest in the world.

ELECTRIC LIGHT STATISTICS.

The use of the electric light has increased during the past year in Canada. According to the returns of the officers carrying out the Electric Light Inspection Act, there were last year 324 plants in the Dominion with 14,780 arc lights, and 1,212,861 incandescent lights. Taking the arc as equal to ten incandescent lights, the country had on 30th June, 1903, 1,360,661 lights in use. This is an increase of 236,865 lights in the twelve months, or over 21 per cent. Where there were five lights in 1902, there were six in 1903.

The growth since 1898 has been, establishments, 1903, 324; an increase of 65; arc lights, 14,780; increase, 4,391; incandescents, 1,212,861; increase 749,246, showing an increase of 42 per cent. in the number of arc lights and of 161.6 per cent in the incandescents.

Of the provinces, Ontario is far away the chief employer of the electric light. This province has 205 of the 324 plants in use in the Dominion. It has considerably more than one-half of the total number of arc lights, and 47 in each hundred of the incandescents. All over the province, cities, towns and villages are lighted with electricity supplied either by companies, firms, or the municipalities themselves. Of the latter, thirty-four in the provinces supply themselves with electric lighting.

The province of Quebec, though possessed of enormous water-power, has not adopted electric lighting to the same extent as the sister province. It has 53 plants, 3,853 arc lights, and 409,503 incandescents. It is, therefore, behind Ontario by 4,571 arcs and 158,990 incandescents. It has made, however, greater proportionate gain since 1898 than Ontario, the gain in arcs being: Ontario 36.2 per cent., Quebec 47.6 per cent., and in incandescents, Ontario, 138.6 per cent., and Quebec 212.3 per cent. During the period 1898-1903, the number of plants in Quebec increased by thirteen.

The plants in Quebec are larger than those in Ontario, the average of Quebec's 53 being 15,000 arcs and incandescents, and that of Ontario's 203 being 3,215.

The largest single plant in the Dominion is that of Toronto with its 170,000 lamps, arcs being taken as each equal to 10 incandescents. The next largest is that of the Lachine Rapids Hydraulic and Land Company, 158,503. The third in size is the Ottawa Electric Company with 111,927 lights.

The other provinces have made considerable progress. In the West, Manitoba has increased in 1898-1903 its arc lights from 162 to 373, and its incandescents from 13,800 to 31,905.

The North-West Territories have not increased as rapidly as the other parts of the Dominion, their arcs numbering 29, an increase of four in the period named, and their incandescents numbering 6,677, an increase of 1,997. British Columbia shows the largest proportional increase of any of the divisions of Canada, its increase of arcs being 377 or 82 per cent., and of incandescents 74,297 or 257 per cent. In 1898 British Columbia and Nova Scotia had almost the same number, British Columbia having seven more arcs and 169 more incandescents. British Columbia has now 384 more arcs and 42,326 more incandescents, yet Nova Scotia has increased the number of its incandescents by 32,140 or 111.6 per cent.

The three Maritime Provinces had in 1898, 951 arc lights and 46,977 incandescents, and in 1903 they had 1,267 arcs and 93,120 incandescents, an increase of 33 1-3 per cent. for arcs and of over 98 per cent. for incandescents.

These figures show that an increased use of electric lights is general throughout the Dominion, and that proportionately British Columbia stands first in that increase, with Quebec second, Ontario third, Manitoba fourth, and Nova Scotia fifth.

The Westport, Ont., Milling and Electric Light Co. will have their plant in operation in about a month.

The Electro-Manganese Co. have leased from the New Brunswick Government the Grand Falls water-power for 30 years, and will manufacture ferro-manganese from bog ore The company is now operating a plant at Shawinigan Falls.

THE MANUFACTURE OF COMPRESSED PEAT FUEL.

In its crude state, peat, generally known by the name of "turf," has been the fuel of many in Ireland, Scotland, Holland, Germany, and other European countries. The usual method of preparing peat for fuel is to cut it from its native bed in oblong pieces by specially constructed spades and set them out to dry. After lying for some time they are "turned" (several times if the weather is bad), "footed," "stooked," and "stacked" all by hand labor, but at a cost which prohibits its becoming a commercial article to any great extent. In its crude state peat is bulky, dusty, very friable, and not easily handled, which doubtless has the effect of confining its consumption to the neighborhood of the bog from which it was taken. Machinery for the manufacture of "machine peat," as it is called, has been introduced in Holland, Germany, and other European countries, a report of which may be found in Bulletin No. 5 of the Bureau of Mines, Ontario, which states that: "The drying process occupies from six to eight weeks, and when finished the peat bricks contain about 22 per cent. water, below which point it is scarcely possible by air drying to reduce the moisture in machine peat." As 12 per cent. of the calorific value of any fuel is required to evaporate each 10 per cent. of moisture it contains, it will be seen how important it is to have a minimum amount of moisture in peat as in any other fuel.

T. H. Levitt, of Boston, invented machinery for the purpose of making peat fuel some thirty-five years ago; several plants were erected and his machinery installed in the New England States, but after the attempts had been proven commercially unsuccessful, they were all given up, and nothing has been heard on the subject for many years. In 1866 a company was formed in Montreal to make peat into fuel and succeeded in supplying the G.T.R. with a considerable portion of the fuel used on the Montreal division. The mode of manufacture was taking the peat from its bed by a floating dredge, mixing it with sufficient water to form a thin paste which was "flowed" over the prepared surface of the adjoining bed and allowed to partially dry, when it was cut into blocks, "turned," "footed," "stooked," by hand labor and sent to market containing from 25 to 30 per cent. moisture. The cost of hand labor necessary for this treatment, and the fact that men were hard to get in summer, when no winter work was found for them, constituted the chief difficulties. This, with the short drying season, many weeks being required to prepare fuel in this way, proved too much for those engaged in its manufacture, and the attempt was given up after five years' work, and the expenditure of over $100,000.

This was followed by an attempt to make a peat fuel by a continuous process. Machinery was installed on a scow which excavated the peat, and passed it on to a mechanical expeller, where the water was to be reduced as much as possible. The material then entered a heater where the temperature was over 212 degrees, and the moisture was reduced still further. It was then conveyed in the condition of hot paste into an open tube in which worked an archamedean screw and subjected to a considerable pressure which formed it into a column four inches in diameter. The product was a high class fuel, but the cost made its manufacture a commercial impossibility.

It is only within the last few years that any serious attempt has been made to manufacture "compressed peat," a hard, dense fuel, handled and shipped like anthracite coal, except that it must be kept dry in transit, a commercial article which under certain circumstances takes the place of anthracite coal and replaces wood entirely where used. At the Industrial Exhibition, held in Toronto in September, 1898, great interest was manifested in a Dickson peat press, which ran at intervals during the fair, making an excellent sample of peat fuel which was tested in all kinds of stoves, furnaces, and heaters on exhibition, and proved satisfactory in every case, establishing the fact that compressed peat is a high-class domestic fuel. The only thing necessary after this demonstration was to make it in sufficient quantities to supply the demand, and during the following winter preparations were made for active operations in the opening of spring. Presses were built and companies formed for the purpose of [illegible] peat [illegible] summer saw no le[illegible] eight plants erected [illegible] of Ontario, with [illegible] presses installed.

It is to be regretted that so much money, [illegible] 000, was spent before any one plant had been commercially successful, [illegible] enterprise caused money to [illegible] large [illegible] the method and appliances [illegible] quantities of peat fuel [illegible] have been put [illegible] market during that summer. It was found, however, [illegible] labor and air drying could not be depended upon [illegible] supply of raw material. In fact, air drying [illegible] and labor was proven a failure, and new methods and [illegible] were sought out to meet the difficulty. It was [illegible] the press, which was thought to be the most [illegible] appliance, was unable to stand the heavy duty required of it, and was practically useless. The power required being far too great and the cost for repairs ruinous. It may be well to state here that peat in its natural bed, even where well drained, contains over 80 per cent. water. Ignorance of this fact and of the nature of the material caused a vast expenditure of money in costly experiments. The Trent Valley Peat Fuel Co., of Peterboro, spent about $100,000 and three years' time in proving that peat cannot be taken from its bed, the water squeezed out, and fuel made by any known continuous process commercially. At other places different methods were tried and much money spent but with one exception, without success. Peat is a most deceiving substance to handle, possessing properties which give totally unexpected results and entirely upsetting all theories and the most carefully considered conclusions, unless based upon scientific principles combined with full practical knowledge gained by actual experience in the field.

The report of the Bureau of Mines comments upon these experiments as follows:

"Drying by Pressure not Successful.—Countless attempts have been made to mechanically expel the water from crude peat by pressure, filtration or centrifugal force, all applied in a multitude of ways, but so far these attempts have invariably ended in failure. At the Trent Valley peat works hydraulic presses built for the purpose by Boomer & Boschert, of Syracuse, N.Y., capable, it is stated, of exerting a pressure of 300 tons, or two tons per square inch, were employed, the peat after passing through the macerating machine being loaded on trucks in layers between perforated trays overlaid with filter cloths and in this manner subjected to pressure. Nineteen pressings were made in 10 hours, the output being 14.42 tons of partially dried peat per press. The following summarizes the results so far as removing the water is concerned: Average water contained in peat, entering press, 77.71; leaving press, 63.48.

It will be seen, therefore, that an average of 63.48 per cent. water remained in the peat after pressing. This is almost too high for subsequent drying by artificial heat; but criticizing the results from the other point of view, namely, that of expense, four men and an engineer being required to tend the machine, it must be conceded that the cost was out of proportion to the comparatively small quantity of peat handled and the low extraction of water. The last momentous experiments in this line were carried on for a period of several years at Dusseldorf, Germany, with a patent hydraulic filter press. Unlimited capital was available, and the expenditure amounted to about $100,000, every idea which appeared feasible receiving a thorough trial, so that if at all possible the aim of the process might be accomplished. But all in vain, for the attempt has recently been abandoned as impracticable. Mr. Thaulow thus reports on this point. "It was contended that this press would bring the peat down to contain 50 per cent. water, but it proved difficult to reduce the water even to 60 per cent.; and this required so long a time that for a greater production it would be necessary to employ several presses, which means a large expenditure of capital."

A Successful Canadian Plant.—To Alexander Dobson, of Beaverton, Ontario, belongs the credit of bringing this important enterprise to a commercial success. In the spring of 1899, he purchased a "Dickson" press and breaker, and having erected a small plant

about a mile and a half south of Beaverton on a piece of bog land he had purchased, began the manufacture of peat fuel. The first difficulty he encountered was the impossibility of procuring a sufficient quantity of raw material by the method of hand digging and air drying. Cultivating the surface of the bog and harrowing has also been tried and found inadequate. Any considerable lump of peat even the size of a walnut holds its moisture so long that it makes the harvesting of peat impracticable except by reducing the peat to very finely divided particles and spreading it out over the surface of the peat bed in order that the free moisture may be readily evaporated as in the "Dobson" method. Being of an inventive turn of mind and a practical mechanic, experienced in overcoming difficulties in other branches of manufacturing in which he is engaged, Mr. Dobson soon had an excavator or digger of his own invention driven by electric power at work, which proved satisfactory in taking the peat from its bed, reducing to small particles and depositing it in windrows from which it was spread by hand labor over the prepared surface of the peat bed to dry.

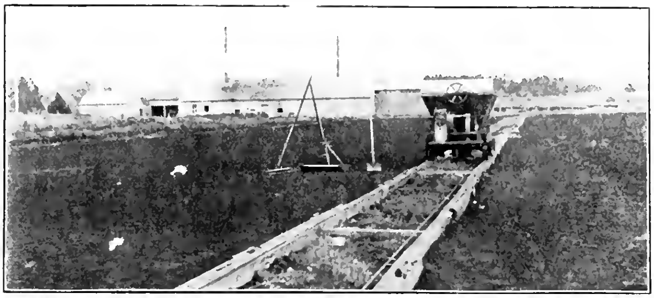


Fig. 1—View of Dobson's Peat Plant, Beaverton. —

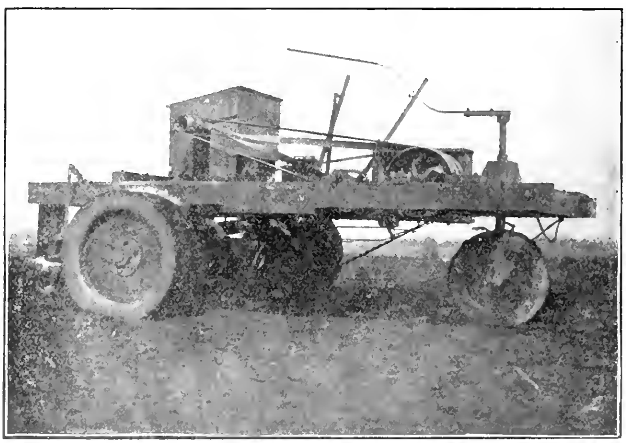


Fig 3—Dobson's Peat Gatherer.

This machine has been improved and tested during the past five summers, a device for spreading the peat by power being added until now but little resemblance to the original digger is left and the "Dobson" Patented Peat Excavator and Spreader is the result. (Fig. 2), an appliance without the use of which it is claimed to be impracticable and next to impossible to make peat fuel commercially under conditions of both labor and climate obtaining in Canada and the United States. By its use and the labor of one man, 250 tons per day of the raw material is excavated, pulverized, and spread out to dry, the evaporation on an ordinary summer day being so rapid that the 80 tons of water in each 100 tons of raw material is reduced to 10 or 12 tons in less than 24 hours; so that the peat excavated to-day is in the storehouse as finished fuel to-morrow. The gathering of the semi-dried peat is done by another machine of Mr. Dobson's invention (Fig. 3), driven by electric power and directed by one man. It gathers the semi-dry material from the surface of the bed and deposits it in a windrow alongside the tram track, from which it is elevated by another appliance driven by electricity into a motor dumping car and conveyed to the works or stack in which it is stored for winter use. Experience shows that peat once dried is very slow in taking up moisture again, and that only six to eight inches of the top of a stack of semi-dry peat will be affected by the rains or snow of autumn and winter, the use of sheds for storing the peat being of little advantage and unnecessary.

Mr. Dobson found it practically impossible to manufacture peat without means of reducing the moisture remaining in it to the required degree for making a proper block of fuel. Again his inventive genius came to his assistance and before the first season was over he had a mechanical drier at work envolving new principles which met the necessity in a remarkable manner and reduced the moisture to any required degree at a small cost for fuel. This was the forerunner of the "Dobson" Patent Dryer, which for four years

Fig 6—Dobson's Peat Briquettes.

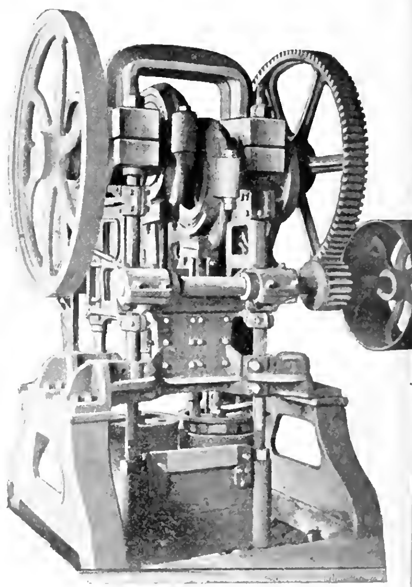


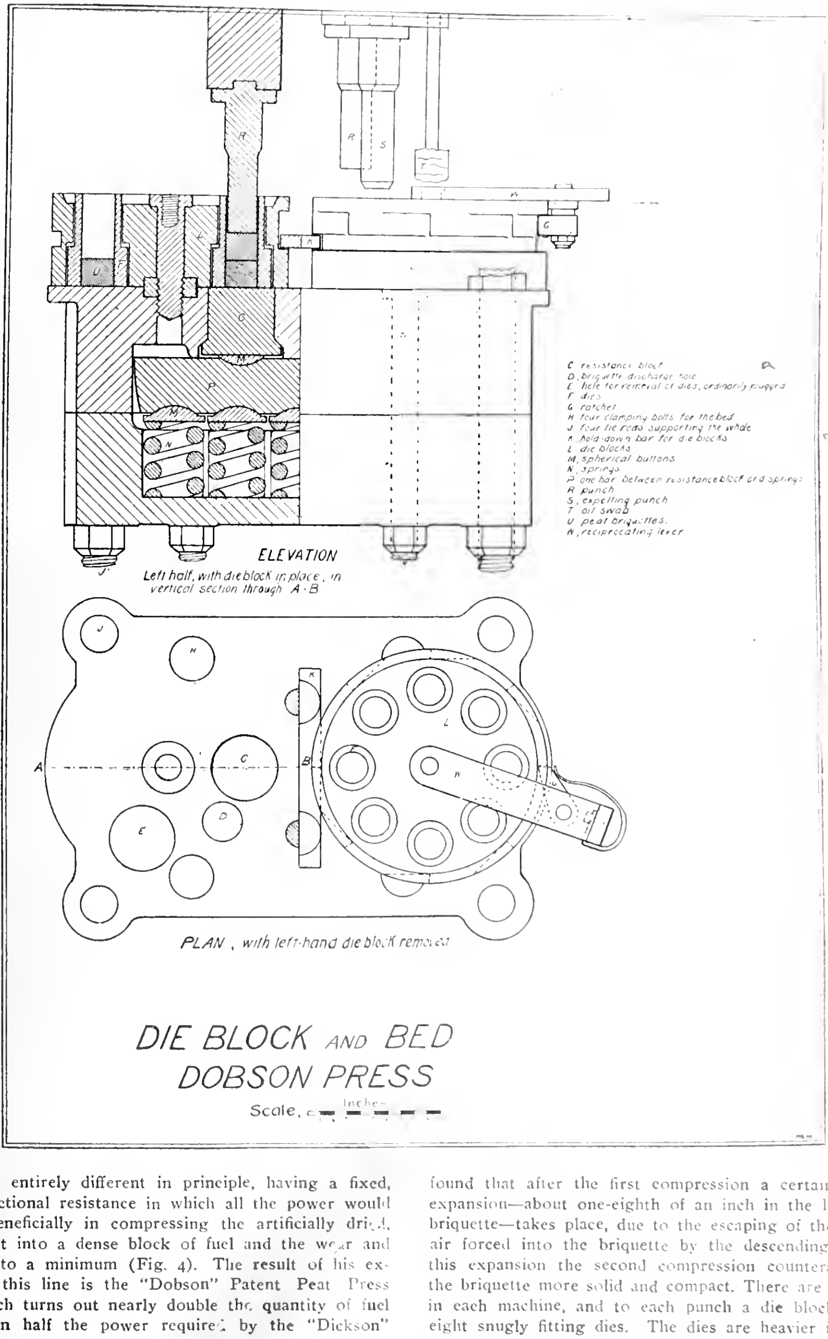
Fig. 5—Dobson's Patent Peat Press.

has proven satisfactory, both as to output and cost of repairs. The cost of installation is moderate, the operation simple and effective, and results most satisfactory.

These two inventions were the result of Mr. Dobson's first season, and being now able to furnish material for the press, he found to his dismay that the very principle of the open tube in which the friction was in opposition to the power, was wrong. On this point the Bureau of Mines' report says: "One difficulty in operating this style of press satisfactorily has proven to be the excessive consumption of power in simply moving the column of briquettes in the dies; in other words, in expelling the briquette from the die.

The tube cannot be of shorter length than sufficient to ensure a sound briquette being made from the poorest quality of peat; but with dense or gritty peats the resistance rises far beyond the required point. This in turn heats the die, causes an appreciable wear on the inner surface, and consumes unnecessary power. The end of this severe duty is usually a broken die or a ripped or cracked gear wheel. A water-jacketting device has been introduced to keep the tubes cool, but apparently not with complete success." The opening of the spring of 1900 found Mr. Dobson at work upon a press, entirely different in principle, having a fixed, instead of frictional resistance in which all the power would be applied beneficially in compressing the artificially dried, powdered peat into a dense block of fuel and the wear and tear reduced to a minimum (Fig. 4). The result of his experiments in this line is the "Dobson" Patent Peat Press (Fig. 5), which turns out nearly double the quantity of fuel with less than half the power required by the "Dickson" open tube press.

The report of the Bureau of Mines refers to this press as follows. "In the Dobson press friction is entirely eliminated, [illegible] us to being [illegible] ing oiled to prevent [illegible] the peat against the [illegible] in the subsequent expulsion of the briquette. The [illegible] ber of dies employed [illegible] punch keeps the temperature low. The briquette is allowed to remain in the die in which it is formed for one cycle of the system (about six seconds) and is then subjected to another compression by a second briquette being formed on top of it. Immediately after this it is expelled and the second block takes its place. It is found that after the first compression a certain amount of expansion—about one-eighth of an inch in the length of the briquette—takes place, due to the escaping of the imprisoned air forced into the briquette by the descending punch, and this expansion the second compression counteracts, leaving the briquette more solid and compact. There are two punches in each machine, and to each punch a die block containing eight snugly fitting dies. The dies are heavier in the lower end where the compression takes place. The base block, against which the briquettes are formed, remains rigid, un-



DIE BLOCK AND BED
DOBSON PRESS

less for any reason the strain exceeds the working pressure, when a set of spiral steel springs, on which the block rests, takes up the excess pressure and prevents any breakage. The down-thrust of the punches is imparted by two heavy eccentrics faced with roller bearings, and with each stroke of the punch the die block is turned through one-eighth of a revolution. Working in the next die to the compressing punch is the releasing punch which expels the finished briquette, while the third receives an oil swab which coats the inside of the die with a film of crude petroleum, to lessen the friction and facilitate expulsion of the briquette. The two punch-systems of the press act reciprocally, a stroke being delivered at every half revolution of the eccentric shaft. With each down stroke the compressing punch forms a briquette on top of the one previously made in the same die, the discharging punch expels from the next die the bottom or completed briquette, and the third die receives its coating of oil from the oil swab. The cut illustrating the die block and bed of the Dobson press may serve to make clear the construction and working of this part of the machine. Power is transmitted through belting to a pulley on the pinion shaft, and thence by a 5-foot gear wheel operating the eccentric shaft. The machine is steadied by a heavy fly-wheel on each of these two shafts, and runs quietly and with little vibration, notwithstanding the immense and sudden pressure exerted twice every revolution. It makes 50 to 51 revolutions per minute, producing 100 or 102 briquettes per minute. Twenty-five briquettes weigh about 10 lb., consequently the output of the press in ten hours is about 12½ tons finished fuel. To operate the press with the accessory shafting, conveyors, etc., 13-h.p. is required."

A perfected press was installed in the spring of 1901, and has been run for three seasons giving the utmost satisfaction, and costing but little for wear and tear. Mr. Dobson's plant has been the centre of great interest during the past two seasons. People from all parts of Canada and the United States have visited it and inspected its operation. The Director and Secretary of the Bureau of Mines, Ontario, the United States Consul at Toronto, and several mechanical experts have made reports thereon. Three well known mechanical experts of Toronto, one representing the Norwegian Government, besides several sent by interested parties from the United States, England, Mexico and India, have inspected the plant and process, and given estimates on the cost of production. Without exception, all have reported that Mr. Dobson's claim is more than filled, viz., that with his appliances installed upon a suitable bog, a good commercial article of fuel can be made from peat in a plant of the capacity of 50 tons per day of twenty hours at a manufacturing cost of less than $1.25 per ton. On this point we quote, as follows, from the Bureau of Mines' report on the plant at Beaverton, as found by their expert: "On an output of 12½ tons per day, the total cost of manufacture is $1.01 per ton for the actual operating cost, nothing being allowed for interest on capital invested, wear and tear of machinery, royalty charges, or profits."

Mr. Dobson has installed but one press at his plant, as his peat bed is not large enough to warrant more and the product is sold mostly in the immediate neighborhood. About 500 tons were shipped to Toronto during the past year where it sold at $5 per ton, giving general satisfaction, anthracite coal selling at $6.50 per ton.

There is now no doubt in the minds of those who have investigated the matter that the vast peat fields of Canada and the United States can be utilized as a superior domestic fuel, so much required, especially in Ontario, where the supply comes largely from a foreign country, subject to all the conditions which may be imposed by the demands of the labor unions, as well as the railways and coal trust.

The writer is indebted to the courtesy of the Minister of the Bureau of Mines, Ontario, for the loan of the cuts illustrating this article.

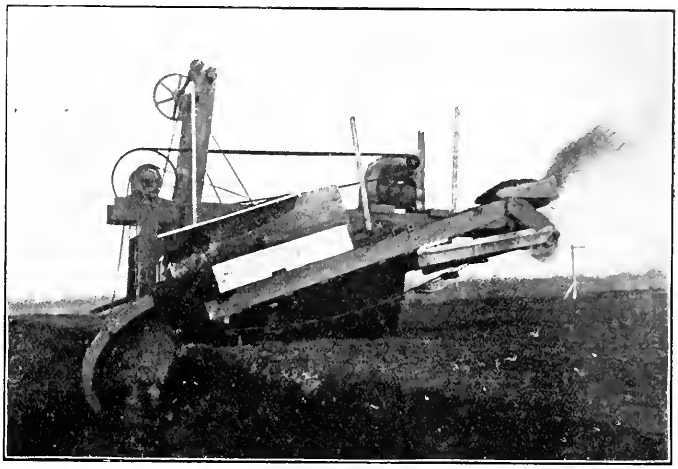


Fig. 2.—Dobson's Peat Excavator and Spreader.

THE METRIC SYSTEM.

Editor, Canadian Engineer:—

Sir,—I have read the letter on this subject, signed by F. A. Halsey, which appears in your issue for the current month and beg to offer a few comments thereon. Mr. Halsey commences by saying that there is no foundation in fact for the statement that the Metric System has been adopted by forty-four countries.

Now it is no use meeting assertion by contradiction, but I would suggest that Mr. Halsey should send a consignment of goods to any civilized country, excepting Great Britain and dependencies, Russia and Denmark, and he will find that the custom house of any country he may select will insist on his papers being in terms of the Metric System.

Admitting that the use of the Metric System has not as yet, in countries which have recently adopted it, permeated the whole of the interior commerce, your readers will quickly appreciate the argument that, for all purposes of international trade it involves the use of the system by consignors to that country, if it be officially adopted and required by the customs houses.

It is not a fact that in France and Germany there are used old units, side by side with those of the Metric System. There do exist old names—or nicknames—for some of the present units, but it would be just as true to say that we have two coins here of the value of 6d. because it is sometimes called a "Tanner" as to assert that the "Livre" as a

definite weight is still used in France. It is a nickname sometimes applied to half a kilogram.

There are so few opponents of the proposed adoption of the Metric System in this country that it is really helpful to the movement aimed at by my Association to find such an advocacy as that of Mr. Halsey, but he makes a great mistake when he says that the strength of the movement lies with the scientific men. This Association was organized under the auspices of the London Chamber of Commerce, and is supported (as you will see by the enclosed list), by thirty chambers in all parts of the British Empire. It includes among its subscribers, the following well-known manufacturing and mercantile firms:

Sir W. G. Armstrong Whitworth & Co., Limited, Atkin Bros., Sheffield; Babcock & Wilcox, Limited, The Central Marine Engine Works, West Hartlepool; J. Bibby & Sons, Liverpool; Bovril, Limited; Thomas Briggs, Limited, Manchester; British Mannesmann Tube Co., Limited; Brown & Polson; Brunner, Mond & Co., Limited; Cadbury Bros., Limited; Clayton, Son & Co., Limited, Hunslet, Leeds; Clayton & Shuttleworth; David Colville & Sons, Motherwell; J. & J. Colman, Norwich; Jos. Crossfield & Sons, Limited, Warrington; Debenham & Freebody; The Messrs. Denny, Dumbarton; Fraser & Chalmers, Limited; R. A. Hadfield & Co., Sheffield; Harrod's Stores; Hobson, Houghton & Co., Sheffield; G. B. Hunter, Wallsend-on-Tyne; Ipswich Engineering Society; Dr. Jaeger's Sanitary Woolen System; Jonas & Colver, Sheffield; Kayser, Ellison & Co., Sheffield; The Lancashire Explosives Co., Limited; Manfield & Sons, Northampton; The Salford Iron Works; Mappin Bros.; Sir Hiram Maxim; North British Locomotive Co.; A. & F. Pears, Limited; Ransom, Sims & Jeffries, Ipswich; Rudge-Whitworth, Coventry; Rushton, Proctor & Co., Lincoln, The Salt Union; Siemens Bros. & Co.; The Tyne Iron Shipbuilding Co.; Vickers, Son & Maxim. Moreover, it has been for a long time supported by retail trade associations, and by the trade unions and lately by several town and county councils.

I am not an engineer, so must not attempt to deal too fully with the screw thread difficulty, but I may perhaps be allowed to say that I was present at a debate on this subject before the members of the Institute of Electrical Engineers, when Alexander Siemens, C.E., produced four screws, two made on a lathe with a metric lead (a 4 m.m. leading screw), and two made on a bench with an eighth of an inch leading screw. With these he produced two nuts. The nut for the 4 m.m. pitch was made with a French tap, and the nut for the two screws of the eighth of an inch pitch was made with an English tap. No one was able to tell Mr. Siemens which of the two screws were made on the m.m. pitch and which on the other. From this example I concluded that there was not much in the screw thread objection.

As Mr. Halsey concludes his letter by reciting the names of some opposing organizations in the States, I may perhaps be allowed to quote the following passage from the Annual Report of the Secretary of the Treasury of the United States for the year ending June 30th, 1903:

INTERNATIONAL METRIC SYSTEM.

"During the year the attention of this Department has been forcibly called to the growing need for international uniformity in so fundamental a necessity as weights and measures. The Customs Congress of American Republics, held at New York, strongly urged the adoption of the metric system to simplify the transaction of Government business in connection with international trade. Moreover, the National Board of Trade of the United States, the Board of Trade of Canada, and the Congress of Chambers of Commerce of the British Empire have recently urged by strong resolutions the adoption of the metric system. The experience of forty countries of the world has proved beyond question that the international metric system is unsurpassed for practical convenience.

The United States Metric Bill, which Mr. Halsey, in a note, states did not become law, has again been introduced into Congress and has been referred to the Committee on Coinage, Weights and Measures at Washington.

Whether there be a desire for the change in the United States or not, the [illegible] ing amount of supp[illegible] there is every pro[illegible] our object, will be pass[ed] [illegible] session of P[arliament].

To take a self-inte[rested] [illegible] be better for us if the Un[ited] States [illegible] in this matter, for it would [illegible] position [illegible] ter able to compete with [illegible] countries, where the Metr[ic] Weights [and] Measures [illegible]

E. Johnson,

Secretary, Decimal Association, London, Eng.

PUMPING BY ELECTRICITY.[*]

(Continued from January Issue.)

The population had more than doubled in the four years preceding the completion of this work of connecting up all the towns. The distribution systems of the towns were extended during that period in even a greater proportion; so that, when finally the pipe system was ready to supply the whole territory, it was apparent that additional pumping capacity was necessary at the lower station if the company was to supply all the water from its own source. An additional capacity of 5,000,000 Imperial gallons was then decided on for the lower station. At that time the Chambly and Lachine Rapids water powers were in successful operation and offering power at attractive rates in the city. Moreover, the load curve of the electric companies had then a severe peak between 4 and 8 p.m., due to the incandescent lighting. This peak during the winter nearly reached the limit of their full capacity. During the other twenty hours there was more than three times as much unused power.

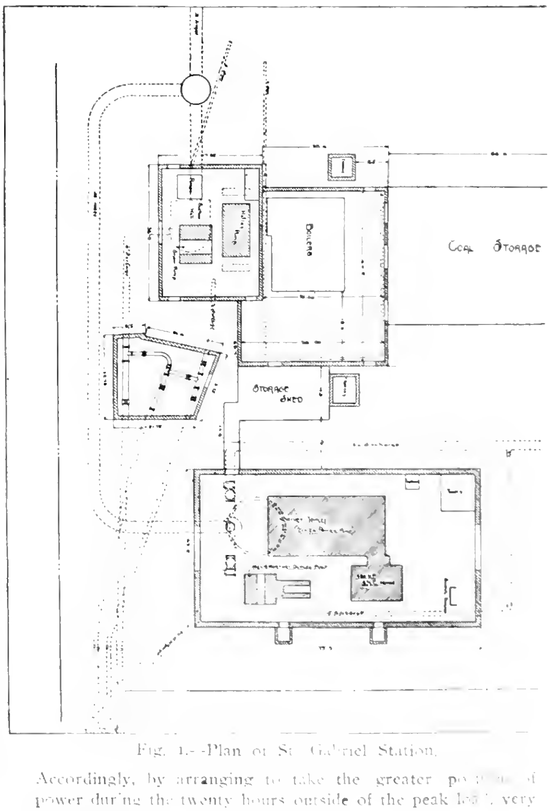


Fig. 1.—Plan of St. Gabriel Station.

Accordingly, by arranging to take the greater po[rtion] of power during the twenty hours outside of the peak load, very reasonable flat rates were obtained.

The capital cost of a 5,000,000 Imperial gallon electric pump was then considerably less than that of a steam plant of equal duty reckoned on a steam basis. The estimated at

[*] From a paper read before the New England Waterworks Association by J. [illegible] Pitcher, C. E., Chief Engineer, Montreal Water and Power Co.

tendance was only two-thirds of that for a steam plant. Electric pumping was therefore decided upon.

Accordingly, the 5,400,000 Imperial gallon triplex electric pump now running at the lower station was installed, and put into operation in 1899.

FIRST ELECTRIC PUMP INSTALLED AT THE LOWER STATION.

This pump is a 21-inch by 24-inch horizontal double acting, outside centre packed power pump, and is direct connected through single reduction gearing, and a "Worrall" friction clutch to a 480-h.p. S.K.C. synchronous motor. The frequency of the power was 66 cycles per second, and a 22-pole machine was adopted. This gives the comparatively low motor speed of 180 revolutions per minute. A piston speed of about 80 feet per minute was fixed, and single reduction gearing adopted with a ratio of 8.88. The gearing

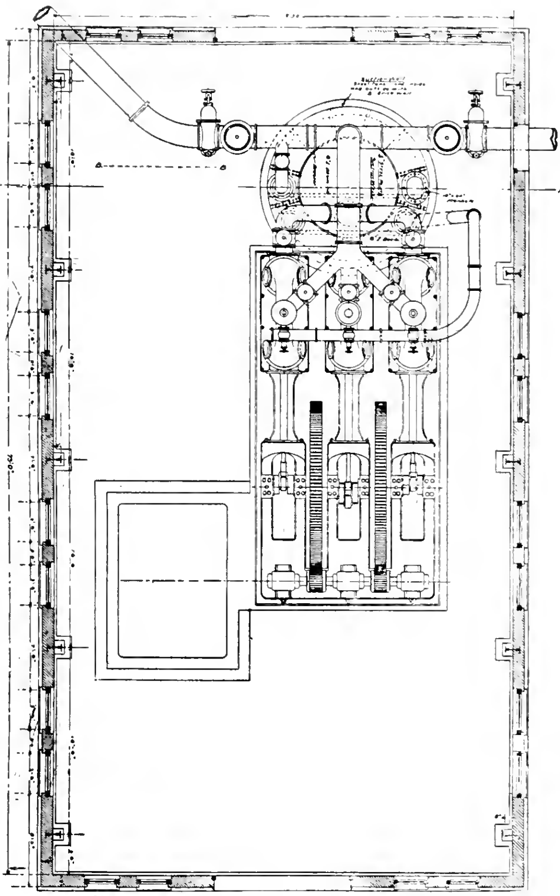


Fig. 2.—St. Gabriel Electric Pumping Station.

arrangement was made symmetrical by using two large gears on the crank shaft, one on each side of the middle pump. There are six main crank shaft bearings, and consequently no overhanging cranks. The jack shaft carries two pinions engaging with the gears. This shaft is carried by pillow blocks resting on the frame of the power end.

The valve area is 65 per cent., there being 36 three and one-half inch valves in each deck. The water chambers are of the externally smooth vertical cylindrical type, having internal ribs. The rigid frame carrying the jack shaft and crank shaft is tied to the pump ends in the usual way by heavy castings, which form the guides for the cross heads. This makes a very symmetrical and pleasing design, with at the same time almost a maximum compactness. Other principal data concerning the power end of this pump are as follows:

2 C. I. Gears 178-in. pitch dam. 160 Teeth 3.494 circular pitch.

2 C. I. pinions 20 12 in. pitch diam. 18 Teeth 3.494 Circular pitch.

Reduction ratio, 8.88.

Average speed of pump shaft has been maintained at 21 revolutions per minute. The three-throw crank shaft is a steel forging, 10 inches in diameter through journals and crank pins, and 12 inches diameter at gear hubs; over all, length 16 feet 2 inches. Steel pinion shaft is 7½ inches diameter through bearings, 9¼ inches at pinions. Rectangular locomotive type connecting rods, 6 feet long, centre to centre. Cast-steel cross heads, circular brass shoes, cross head pins 7 inches diameter. The main bearings consisted originally of solid phosphor bronze boxes and journals as well as the crank pin journals. The bronze plunger rods are 4¾ inches diameter. The three pinion shaft bearings were of the spherical self-aligning type, common to electric generators and motors. They were babbited. The water end was provided with the usual suction run around pipe, a discharge air chamber over each uptake, and one main suction air chamber. Discharge pipe is 20 inches diameter, suction 24 inches diameter. Separate suction and discharge stop gates are provided for each pump, so that any or all pumps could be cut out at will. In addition, a main hydraulic by-pass valve was provided for starting and also for reducing the load on the motor during the four hours of the peak of the load of the electric power company. By means of this valve the pressure is held at any desired point below that of full load. There was also provided an 8-inch spring relief valve of the Ashton type for each pump. These remained set at the same maximum pressure. There are, of course, the usual main discharge, check, and foot valves. A feature of this installation was a new steel intake well, or rather tank, below high-water level in the river, and a 36-inch steel intake pipe connection between this and the 36-inch wooden intake pipe to the old station. The air-charging device is the usual water column and air valve arrangement.

The motor, as above mentioned, is a 480-h.p. two-phase, 66-cycle, 2,400-volt synchronous machine of the S.K.C. type, that is, a stationary field and armature with a revolving inductor. There are then no revolving coils, whatever, merely a cast-iron spider carrying laminated steel pole pieces. A feature of this machine is its large air gap, as compared with induction motors. This gives perhaps greater security in its operation. The fields of this machine are excited in the usual way by a belted 10-K.W.D.C. generator. This little machine is shunt wound, and has a rheostat in both field and armature by which the exciting current of the motor is adjusted. The starting motor is a small 15-h.p. S.K.C. two-phase, 500-volt induction machine, which can be thrown in or out of gear with the 5-foot 4-inch cast-iron spur gear carried on the motor shaft. The speed of the starting motor is regulated by a water rheostat in its motor by means of which the large motor, when in mesh with the starter, is brought into synchronism with the line. There are the usual ammeters, voltmeters, etc., on the switch-board, as well as fuses, lightning arresters, etc. No wattmeters were provided on account of the power being bought on a flat rate based on the maximum load. The lower voltage required for the starting motor necessitates two transformers, one on each phase. During the four years this machine has been operating, the company has had every reason to be satisfied with the motor itself. One stator coil was burned out some years ago, due to the motor going out of step on a short circuit and not being taken off the line in time. As long as normal conditions are maintained on the line, this machine runs with little trouble. This type, and more especially this particular machine has not sufficient regulation to stay in step when a sudden drop in line voltage of any considerable amount occurs. Unfortunately, however, for this type much auxiliary apparatus is found to be necessary. A flat on the commutator of the exciter, not quite enough resistance in its fields, may cause, and has caused in this case, a shut down of serious import. An extra armature is carried for the exciter; but this part of the apparatus has been uniformly found to be the weakest in the electrical equipment. Trouble has also been experienced with

the starting motor transformers. Lightning, not grounded, burned them out at first. They were then provided with switches which enabled their primaries to be taken off the line when not in use. The above accident caused a shut down of nearly a day. The burning out of the little transformers for the synchronizing lamps has also shut the pump down.

On the whole, the points against a synchronous motor from the user's standpoint are found almost entirely in its auxiliary apparatus. On the other hand these motors are virtually more efficient than their induction rival, inasmuch as the central station, or people selling the power, often take account, in fixing the rate, of the power factor of the motors they operate. By over excitation, as is well known, the power factor can be brought practically to unity; in other words, the wattless current is wiped out. In that case the consumer gets all the power he pays for; in the other

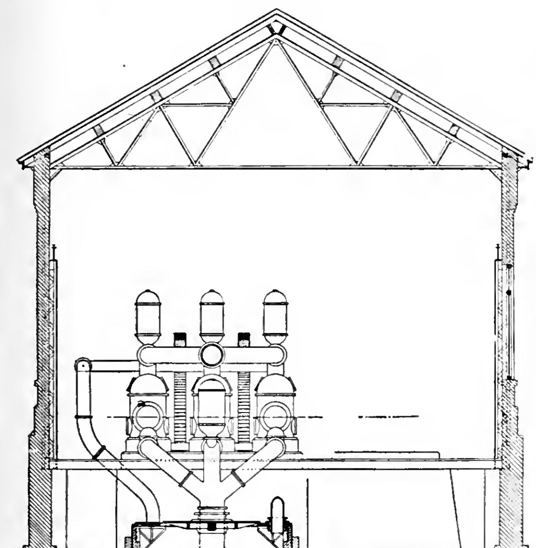


Fig. 3.—St. Gabriel Electric Pumping Station.

only, say, from 70 to 90 per cent., depending on the ratio of the true to the apparent watts of the motor. If no account of this is taken by the central station then everything is in favor of the induction motor. However, more will be said about this type of machine when describing the Clarke Ave. plant.

To return to the operating of the pumps: In order to reduce the noise of such heavy and comparatively high-speed gearing (980 feet per minute), to a minimum, raw-hide pinions were at first adopted. These were built up in the usual way with layers of raw-hide on a cast-iron centre and held between shrouds in one piece with the centres. Steel bolts were inserted from end to end and an inch or more extra raw-hide face provided to allow for taking up shrinkage. These, when they ran well, were very noiseless and smooth, but it was soon apparent that they would not answer. The middle of the tooth seemed to spring away from the work and leave the ends near the shrouds to do most of it. This caused excessive wear. Moreover, the shrinkage with this raw hide was so great that fibre had to be inserted at the ends in order to take it up. Finally it became impossible to take up the shrinkage. The raw hide seemed to loosen between the shrouds, and the pinions failed by cracking at the root of the teeth. While this was going on the vibration in the large gears was extreme and the noise excessive. It was essential to start this pump again without any unnecessary delay. Shrouded machine moulded pinions were therefore procured and are running to-day but, as might be expected, with considerable noise. The wear has also been great, and the writer has concluded to abandon the two sets of gearing, [illegible] in the pit next the motor. The frames are fortunately wide enough to allow a 21½-inch face, which will be ample for the 300-h.p. now transmitted by these gears. The crank shaft is also sufficient to allow this change. It has, moreover, been decided to get 10 per cent. more water out of that pump than at present by reducing the reduction ratio. A single pair, consisting of a machine-cut cast-iron gear and machine-cut steel pinion, is now on order for this pump. Another source of trouble at the start was found in the phosphor bronze boxes. There was too much anxiety for the water from this pump to give these a fair chance to come to a surface. They took this occasion to heat badly and seize, and therefore had to be afterwards lined with babbit. Thus equipped, this pump has run without any extraordinary repairs since October, 1899, to the present time.

EFFICIENCY TESTS.

By testing this plant with a Weston direct reading wattmeter on the motor circuit, and indicating the water cylinders at the pump end with Crosby indicators, an overall efficiency as high as 85 per cent. from electric line to water has been observed. There is, however, considerable difficulty in observing the electric input with these sensitive watt meters. This is due to the irregular oscillation of the needle. But there is every reason to believe that the above figure is within 2 or 3 per cent. of the truth. Taking the average price of coal in Montreal, and the price per horse-power of electric power, we obtain a duty from this pump on a basis of foot pounds per 100 pounds of coal, about 87,000,000.

The writer entered the company as chief engineer in September, 1899, while this pump was making its trial runs. When it was finally started, it was at once apparent that the intermediate station on Clarke Ave. was not able to carry the additional load and thereby furnish all the water for the high levels and back territory. The boiler and chimney capacity were added to as a makeshift until something more permanent could be done, as it was at once made clear that the direct acting duplex pumps at this station were neither sufficiently large or efficient to do the work required. It was also clear, at the same time, that there was not sufficient force main capacity even for the present requirements between the lower pumping station and Clarke Ave. Station. At the lower station, with the new pump running, the pressure was 145 pounds and the lift only 200 ft. The new electric pump was designed for 120 pounds' pressure.

It was, therefore, decided to increase the capacity of the force mains and that of the pumping plant at Clarke Ave. Accordingly, a new 24-inch main was laid to St. Henri, and 14-inch and 16-inch mains in that town—the former one across the town from east to west, and the other straight north and south to Westmount. This gave three force mains, 12, 14 and 24 inches in diameter, about 6,500 feet in length from the St. Gabriel Station to the St. Henri and Ste. Cunegonde gridirons. In passing, an interesting feature of laying force mains from this station to the main system is the necessary crossing of the Lachine Canal. The pipes have to be laid to give a clear 20-foot waterway and the bottom of the canal, where the company's crossings have been made, is a *quasi* quicksand. The work is, of course, done at the low water during the Government repairs to the canal in the spring, but the material in the bottom renders coffer damming and trenching difficult. This new work when completed reduced the pressure to 85 pounds, with 5,500,000 Imperial gallons' consumption. It has now worked up to between 93 and 94 pounds.

Besides the consideration of economy, there was another and perhaps a more important factor to consider in deciding

on the type of pump for Clarke Avenue. The surrounding property is of a purely residential character and of a good order. The pumping station is on a very steep hillside. The smoke and hauling of coal up the hill incident to the operation of a commercial steam plant were much complained of by the neighbors, and proceedings were threatened. Knowing, however, that it was a choice between some noise and vibration in the immediate vicinity on the one hand, and smoke and dirt over a broader area on the other, the choice fell to an electric plant.

(Continued in next issue.)

+ + +

MINING IN SOUTHERN BRITISH COLUMBIA.

The New Year issue of the Nelson, B.C., Daily News contains a very comprehensive review of the mining industry in southern British Columbia, based upon authentic information obtained by reliable writers, of which the following is a summary:

A mineral production, value nearly $12,000,000, is the result of mining in southern Kootenay and the Boundary district of southern Yale for the year 1903. These are approximate figures, but they are as accurate as the necessarily incomplete data obtainable before the year closed, and the final figures available permitted. To be exact, the estimate of the president of the Associated Boards of Trade of Eastern British Columbia, was $11,932,639.10, in the following proportions:

	Quantity.	Value.
Gold, ozs.	204,147	$4,219,718 49
Silver, ozs.	3,471,421	1,830,953 13
Copper, lbs.	24,866,977	3,332,174 92
Lead, tons	10,168	489,792 56
Total metallic production		$9,881,639 10
Coal, tons	652,000	1,304,000 00
Coke, tons	166,000	747,000 00
Total mineral production		$11,932,639 10

The total production of gold, silver, copper and lead in Canada east of the Rocky Mountains in 1902 was: Gold, $279,836; silver, $399,629; copper, $1,107,022, and lead, $11,038; total, $1,837,525. The figures for 1903 are not available for comparison, but with a liberal increase for last year it is apparent that southern British Columbia leads the way, besides which the remaining mining sections of the province last year had a total production equal to 80 per cent. of that east of the Rockies. The Kootenay is behind the eastern provinces in coal production, but this industry is making rapid progress. It must be stated, however, that in 1902, besides coal and coke, value $12,245,284, the other provinces had a production of iron and nickel valued at $6,103,882, so that the aggregate production of metallic minerals was proportionately larger than the mineral production of British Columbia. The aggregate production of metallic minerals in Canada east of the Rocky Mountains in 1902 was, however, nearly $2,000,000 less than that of the Kootenay and Boundary districts in 1903. It is claimed for this province that it is the mining province of the Dominion and the foregoing comparisons are made to emphasize the fast increasing right British Columbia has to this distinction.

Before noticing the Kootenay and Boundary, some general remarks relative to other parts of the province are given On Vancouver Island and other coast parts there was considerable development and production in several mining sections. At Mount Sicker work was confined to the Tyee, Lenora and Richard III. properties. At the Tyee two miles of work have been done underground in this copper-gold mine, chiefly in the opening up of the southern ore body occurring on it, this being up to 40 feet in width in places. A cross cut from the south walls is being run at the 165-foot level to explore the property to its full extent. Two ore bodies been have passed through, and beyond these lode matter has been encountered. During the year the capacity of the mine aerial tramway was doubled, enabling shipments to be made at the rate of 5,000 to 6,000 tons per month. At the Ladysmith smelter, owned by the Tyee Copper Company, there was smelted in 1903, 50,000 tons of ore (including custom ore), this producing 4,700 tons of matte valued at $500,000. The company owning the Lenora mine got into financial difficulties, but the property is now under lease to the principal members of the Northwestern Smelting and Refining Co., operating the smelter at Crofton. The outlook for the Lenora is favorable, with a considerable amount of ore of a commercial grade in sight and other shoots within reach. The tonnage of ore treated at Crofton could not be ascertained, but besides the Lenora ore shipments were received from Marble Bay and Van Anda, on Texada Island; Quatsino Sound, where the smelter people are now operating the Yreka mines; Gribble island, Republic (Washington), Alaska, and other parts.

Coal mining on Vancouver Island was seriously interfered with in 1903 by labor troubles. Since then the production at all three collieries has been 15,000 to 20,000 tons per week. The Wellington Colliery Company's output for the year was 581,013 tons, shipments having covered eight months. Work is in progress at Cranberry pumping the water out of No. 2 slope of the Wellington colliery, which was flooded two years ago to extinguish a fire, but it will be at least another year before the water will be all out. An important discovery of anthracite coal has been made in No. 7 slope. The seam is four feet in thickness, and it is expected that this coal will be placed on the market early this year. The Western Fuel Company, which acquired the collieries of the New Vancouver Coal Company, made considerable additions to the machinery and plant and extended operations in its coal mines. Much of the product of its mines is exported to California. There is not much to chronicle about placer gold mining, either in the Atlin or the interior districts. Operations have been restricted by a shortage of water. In Cariboo the smaller properties have made a better showing, comparatively, than the big hydraulic concerns, for they were able to take advantage of heavy rains that fell late in the season, by which time the working forces of the companies had become tired of waiting for water and had left for other parts for the fall and winter seasons. The output of Cariboo will probably be $300,000, and that of Atlin $400,000. Much machinery has been installed at Atlin, and the prospects are in favor of hydraulic mining being carried on by companies rather than placering by individuals. Little was done in Omineca, where the Arctic Slope Company recovered about $15,000 worth of gold. The Thibert Creek Company, Cassiar, recovered about $25,000 worth. For the East Kootenay placer camps, Wild Horse and Perry Creeks, a like sum is believed to be a fair estimate. The Big Bend of the Columbia, above Revelstoke, saw some activity, but it is not known that much gold was recovered.

The Boundary District is first among the ore-producing sections of the province. The ore being of low grade, it is necessary to operate on a large scale in order to earn a profit, and this fact has tended to amalgamation, so as to secure uninterruptedly a large supply of ore. The larger mines have a daily output of 600 to 800 tons, and in one case 2,000 tons. Those mines owning smelters are making money, most profitable results ensuing where several furnaces can be kept running continuously. The British Columbia Copper Co., Limited, of New York, owning the Mother Lode mines and the smelter at Greenwood, and the Snowshoe Gold and Copper Mines, Limited, of London, England, owning the Snowshoe group, near Phoenix, have agreed to consolidate, and it is proposed to organize a new British company with a capital of $5,000,000.

In the Rossland district, a more hopeful feeling exists, due, no doubt, to the adoption of new methods and the introduction of more modern machinery, amongst which may be mentioned, the "Elmore" oil concentrator at Le Roi No. 2, the preliminary mill and concentrator, and 50-ton "Elmore" oil plant of the Rossland Power Co. The belief that the "Hendryx" electro-cyanide process is suitable to the low grade ores, and the success attending deep mining at Le Roi and White Bear, at depths of 1,350 feet, and 1,000 feet respectively, also tends to justify a more encouraging outlook for 1904.

In the Slocan district two matters stand out prominently: (1) The bounty to be paid on lead produced in Canada, and its effect on the silver-lead mining industry of the Slocan, and (2) the importance of turning to profitable account the zinc contained in some of the Slocan ores. The Payne Consolidated Mining Company, Limited, has got to a point where it can put on the market a desirable quality of zinc product averaging 55 per cent. zinc and carrying some silver values, at the rate of 350 to 450 tons per month. The growing importance to the Slocan of this zinc production question, as compared with that of lead, should be emphasized. In support of this contention it is pointed out that spelter is quoted in London at £21 per ton, while the price of lead, which rules quotations for British Columbia, has been about £11, rather more than half the price of spelter. Further, there is a growing demand and a shortage of desirable zinc ore; while there is an abundance of lead coming from South America and other parts in a position to flood the British market. The president of the Associated Boards of Trade, speaking in Rossland last month, prophesied that under the stimulus of the liberal bounty offered by the Government, the lead mining industry of the province will revive and attain proportions greater than ever before. It is added, that the bounty on lead shipped to Canadian smelters since July 1st, 1903, will probably be settled, and 60 per cent. paid by January 15th. This would involve the distribution of $50,000 to $60,000 at least. With the retained 40 per cent., to follow after June 30th next, the total earnings under the bounty are, approximately, $105,000.

The Nelson district made substantial advances. The Silver King mine shipped nearly 5,000 tons of silver-copper ore to the Hall Mining and Smelting Co.'s smelter at Nelson. The Athabasca-Venus mines had a profitable and continuous production. The development of the May and Jennie property, on Forty-Nine creek, was continued, and in the spring a quartz mill and cyanide plant of 100 tons daily capacity will be installed. The Star group of four claims has been acquired by the Sharpless Mining and Milling Co., Philadelphia, which has leased the Granite-Poorman 20-stamp mill and aerial tramway, and let a contract for hauling from the Star mine about sixty tons of ore a day. Another tram to complete connection between the mine and mill will be put in. The Duncan United Mines, at its Poorman mine, mined and milled 10,000 tons of ore producing approximately 2,500 oz. bullion and 270 tons concentrates. The Juno is now in shape to ship regularly.

One of the most striking developments in the Nelson mining division was the Hunter V. property, near Ymir. The great importance of the discovery, made in 1902, of the large deposit of mineralized limestone, was not recognized at first, but now it is being demonstrated to an increasing extent. The advantages here combined are unusual, including, as they do, a wide area of mineralization with an immense quantity of ore available.

In the Ymir camp several properties were successfully developed. The Ymir mine was operated under difficulties, and, it is understood owing to the low grade of the ore, at a loss, but efforts are being made to find ore similar to that which formerly made the mine a dividend payer. The Ymir district, at the annual Interstate Fair, held in October in Spokane, Washington, secured first prizes for gold nugget and free milling gold ores.

An industry connected with mining and centred in Nelson is that of B. C. Riblet's aerial tramway construction, for which, in 1903, about eighty miles of cable was used. All the metal equipment for these trams, except the cable, was manufactured in Nelson.

In the Kamloops district, the outlook is bright. The failure of the dredge upon the North Thompson river caused disappointment. The dredge changed hands and was moved to Tranquille creek, eight miles west of Kamloops. There it has remained, forcing its way up stream, cutting down the banks, and throwing up a barrier which will prevent its return. There is, however, work ahead of it for years. The dredge has handled 1,800 cubic yards of gravel per day. The gravel is at present dredged to a depth of 18 feet, the best values being found in clay at 15 feet. It is understood to be a paying venture, and operations will be renewed next year. Other str[illegible] gold, it is prob[illegible] dredges operating [illegible] Hill the Iron [illegible] per King properti[illegible] good progress.

Some months ago [illegible] C. Exploring Syn[illegible] owns the Iron Mask [illegible] with the A[illegible] Limited, London, Eng[illegible] plant, and a concentrator [illegible] Prior to this about 4,000 [illegible] the 500-foot level, and [illegible] the diamond drill has been [illegible] power plant and concentrator [illegible] Engineering Works, and the C[illegible] Dr[illegible]

The Copper King property [illegible] at length become a shipper, [illegible] been received from the smelter.

In the Lardeau district substantial progress [illegible] made. In the Fish river portion the erection of [illegible] mills at Camborne gave an impetus to mining, the [illegible] perties directly affected being thereby placed in a po[illegible] to pay the cost of operating. The similar development [illegible] other properties is being also encouraged. In the [illegible] of Ferguson, the further development of the mines [illegible] Great Western and Silver Cup Companies, and the [illegible] provision of plant and other facilities for the reduction [illegible] their ores, and, in a smaller degree, the working of the T[illegible]une mine, prevented retrogression; wh[illegible] rich surface showings of gold at Polar Creek ca[illegible] influx of population and a general prospecting, with results that appear to justify the expectation of permanent mines being developed there.

THE ENGINEERS' CLUB OF TORONTO.

The annual meeting of the Engineers' Club of Toronto, was held in the club rooms, 94 and 96 King St. West, Toronto, on January 7th, under the presidency of C. H. Rust. The report of the executive committee was presented showing a total membership of 139, an increase of eighteen members during the year. Seventeen meetings were held in 1903, and an excursion to Niagara Falls was made on May 30th last. The treasurer's report showed that the Club is out of debt and has a reserve fund of $320. The weekly luncheons have proved a success, in that they afforded members, unable to attend in the evening, an opportunity of meeting each other, which they otherwise would not have. Additional furnishings have been added to the rooms, thereby improving their appearance, and increasing the comfort of the members. The following were elected officers for the ensuing year: President, Captain Killaly Gamble; vice-president, R. F. Tate; second vice-president, James McDougall; treasurer, A. C. Larkin; secretary, Willis Chipman; directors, J. G. Sing, A. J. Van Nostrand, and W. H. Patton.

The retiring president, C. H. Rust, gave a review of the progress made in a few branches of engineering in the past decade, in the course of which he referred to the questions of sewage disposal, garbage destruction, and street paving, saying in part:

"Dealing with the question of sewage disposal; ten years ago, if purification of sewage was necessary, the system generally adopted was precipitation by chemical means. The number of chemicals that were used or advocated as precipitation agents were numerous, many of them on practical tests proving worthless. Others were abandoned on account of the expense, and after a number of experiments it was found that lime and sulphate of alumina were the most reliable and satisfactory. The process of precipitation removes from 50 to 60 per cent. of the organic matter, and while fairly satisfactory is objectionable on account of the large amount of sludge resulting, and the difficulty of disposing of the same. A number of cities at the present [illegible] are still using this method of disposal. [illegible] systems [illegible] broad irrigation and intermittent downward [illegible] satisfactory, providing a sufficient quantity [illegible] able soil can be procured at a reasonable cost, [illegible] supervision is exercised, but in many cases, [illegible]

lessness and on account of placing more sewage upon the land that it could possibly dispose of, a nuisance has been created and other means of treatment had to be adopted. These methods of treatment have in some instances been superseded by septic tanks and contact beds, which has to some extent remedied the sludge nuisance. It is estimated, I believe, that the sludge produced after septic tank treatment is only one-seventh of that resulting from chemical precipitation. After tank treatment, the effluent is passed on to contact beds, composed generally of cinders, although broken stone and gravel have been experimented upon with fairly good results; coke, which was generally used, having proved unsatisfactory. A number of towns and cities in England have been experimenting with this method of sewage disposal for a number of years, and the results have been on the whole satisfactory, so much so that Manchester has adopted this system and the works are now under construction. The method of disposal in that town up to the present time has been precipitation by chemical means. Two important points which have not yet been fully decided upon is the life-time of the beds and the annual cost of operation. I, however, think that in this country, where suitable land can be obtained at a reasonable cost, septic tank treatment followed by after purification upon land will be found the most satisfactory method of disposal. I do not anticipate any difficulty owing to our severe climate. In England, in some cities the sewage is placed upon the contact beds by means of a continuous, revolving sprinkler, which has been found very satisfactory, but I do not think it would be possible to adopt this system during our winter months. I need hardly point out that in the operation of any sewage disposal works it is absolutely necessary, in order to ensure good results, that the works are placed in charge of experienced men, and that a chemist be employed to make frequent analysis of the effluent.

"Another important matter that municipal engineers have to deal with is the question of garbage disposal. Until recent years, the method of disposing of garbage, street sweepings, ashes, etc., was by dumping them in some low and unfrequented spot, but the great growth which has taken place during the past ten years in our large cities has rendered this impossible, and other means of disposal had to be considered. In England and on the Continent every city of importance has one or two garbage destructors in service and this method of disposal has been adopted in a number of American cities. In England these destructors not only satisfactorily dispose of garbage, but also generate steam for commercial purposes, such as electric street lighting, etc. There has recently been introduced in the United States what is known as the "Edson" system of garbage disposal, whereby the garbage is treated in digesters and the grease and fertilizing material extracted. The patentees of this process anticipate a considerable profit, their estimates running as high as $4 per ton."

Referring to the paving of streets and sidewalks, in Toronto, Mr. Rust said: "In 1887 the first asphalt pavement was laid in this city and there is now about [illegible] miles of this class of pavement. At that time the only paving material used was cedar block and macadam. In 1892 the mileage of cedar block pavements had reached 117, and it is now reduced to 45. This class of pavement has never been a favorite, largely owing to the fact that the first pavements laid were allowed to become worn-out and dangerous, as no repairs were attempted nor was any repaving done. Cedar block makes a very good pavement for five or six years: it is cheap, noiseless, and easily repaired, whereas macadam is very dirty in wet weather and very dusty in dry weather, and a very expensive pavement to maintain. I think the ideal pavement for city streets are wooden blocks treated with a preservative and laid on concrete, asphalt and brick, although the latter is objected to on account of the noise. One of the most important questions to be considered in the construction of pavements, especially in large centres of population, is freedom from noise. This matter has not received the attention that it should, especially in American cities, but in London it was an important factor in deciding upon the use of the wooden block pavement. There is about 14 miles of brick pavement in this city, and so far it has given good satisfaction, with the exception of the noise. Very few repairs are required, whereas during the past year we spent about $18,000 upon asphalt repairs, exclusive of the repairs carried out by the various contractors under their guarantees. In this connection there is another matter that has been very much discussed and upon which engineers hold diverse opinions, viz., the question of the guarantee. In Toronto for some years past we have called upon the contractor to guarantee all asphalt pavements for a term of ten years, which I think is the most satisfactory method. In one or two of the large American cities they are now, I understand, only calling for a short term guarantee. This entails an outlay for a very extensive system of tests and even with exhaustive laboratory tests, I do not think it is as satisfactory as a long-term guarantee. I think it is a question whether we are justified in throwing upon the property owners the extra expense involved owing to the contractor being called upon to keep the pavement in repair for ten years. Within the past few years concrete has been substituted for plank in the construction of sidewalks, and up to the present time there is about 35 miles of concrete sidewalks, as compared with one and one-half miles in 1890. It is very satisfactory, except during extremely cold weather, when it becomes slippery, and we are now considering the question of having the surface coat roughened to obviate this difficulty.

"Regarding waterworks matters, during the past ten years, owing to the improvements made in pumping engines, the cost of pumping water has been very much reduced. For instance, in 1890, the cost of pumping water in this city, including coal, wages, maintenance, interest and sinking fund, was 7.52c. per 1,000 gallons. In 1900 this was reduced to 4.86c., and we are now installing a 15-million gallon triple-expansion vertical engine, by which we hope to still further reduce this cost."

ELECTRICITY SUPPLY STATIONS IN GREAT BRITAIN.

In a paper read before the last convention of the Municipal Electrical Association, of Great Britain, Alderman J. P. Smith, ex-Mayor, and chairman of the Electricity Committee, Barrow-in-Furness, calls attention to some very important facts, regarding the supply of electricity by companies and municipalities, which cannot fail to be encouraging to all who are in favor of the supply of electric light and power, by the municipalities. Mr. Smith states that the difficulty and danger of dealing with figures has not been overlooked, but in this case the figures have not been selected to try and prove any theories previously held, but rather the whole of the available returns are presented to see whether any instructive lesson can be deduced therefrom.

It will be seen from the following table, that the number of municipal stations in operation is practically double that of the companies, while of the works under construction, the proportion is nearly three to one, and of the orders still to be put into operation, almost the whole are in the hands of the municipalities:

	Municipal.	Companies.
Works in operation	204	103
Works under construction	104	36
Orders obtained	114	19
Totals	422	158

In the earlier days of the industry, most of the pioneer work was done by companies, but the majority of municipalities soon saw the advantages to be derived from having the control of such an important and profitable undertaking in their own hands, and it is an interesting and notable fact that fifteen towns and cities who allowed private enterprise to step in and take up this work at the commencement have since seen the folly of that course and have bought them out, often at a very big price. In no case has

a municipal supply station, when once started, been transferred to a company.

Financial Results of British Municipal Electricity Undertakings for Years 1896-1901, Inclusive.

No. of Undertakings.	Year.	Capital. $	Revenue. $	Total Costs. $	Gross Profits. $	Interest. $	Interest. Per 1000 Watt Hour. Cents.	Sinking Fund. $	Sinking Fund. Per 1000 Watt Hour. Cents.	Interest, Depreciation and Sinking Fund. $	Total Cost per 1000 Watt Hour, including Interest, Sinking Fund, etc. Cents.	Cost per 1000 Watt Hour. Cents.	Per 1000 Watt Hour. Cents.	Units of 1000 Watt Hours sold.
50	1896	17,357,480	2,028,065	990,910	1,037,155	431,580	2.10	470,030	2.28	901,610	4.38	4.84	9.22	19,691,042
60	1897	22,647,725	2,814,155	1,493,605	1,420,550	549,000	1.72	557,285	1.74	1,106,885	3.46	4.34	7.80	30,721,564
66	1898	33,366,700	3,968,770	1,940,845	2,027,925	746,140	1.52	788,350	1.60	1,534,495	3.12	3.94	7.06	47,204,575
75	1899	45,902,240	5,237,400	2,778,015	2,459,385	1,168,660	1.62	943,695	1.30	2,112,355	2.92	3.82	6.74	69,562,652
97	1900	65,647,660	7,592,170	4,519,900	3,072,270	1,304,275	1.14	1,352,615	1.20	2,656,890	2.34	4.00	6.34	108,681,443
123	1901	84,525,170	9,979,105	5,339,815	4,639,290	2,390,905	1.48	1,838,845	1.14	4,229,750	2.62	3.30	5.92	154,615,336
			$31,619,665	$16,963,090	$14,656,575	$6,591,160		$5,950,820		$12,541,980				430,476,615

CAPITAL INVESTED, 1902-03.

213	municipalities	$117,587,05
157	companies	107,800,995

OUTPUT IN KILOWATTS.

178	municipalities	162,305,417
92	companies	84,404,279

Dealing with the average capital outlay per kw. for the past eight years, it is gratifying to notice that, whatever the system in vogue, the municipalities show much the better results. Thus in the case of alternating current plant the municipal cost is only $460 per kilowatt, as against $5– for the companies, whilst a comparison of direct current stations shows an outlay of $445, against $645; or, by grouping the whole of the stations together, the cost to municipalities is $450, and of companies $585. These figures cover a period of eight years, totalling altogether 820 returns, and in the case of the last year, extend over no less than 182 separate stations, and may, therefore, be taken as a pretty reliable estimate of the cost per kilowatt installed. They should satisfy the most rabid anti-municipalist that in electricity supply stations at least, local authorities obtain good value for the money spent.

Dealing with the relative cost of alternating and direct-current systems, it will be seen that in the case of municipalities the balance is in favor of direct current, whilst in the case of companies it is very strongly the other way.

COST OF PRODUCING 1,000 WATT HOUR IN 1901.

	Direct Current. Stations.	Direct Current. Cost in Cents.	Alternating. Stations	Alternating. Cost in Cents.	Total. Stations	Total. Cost in Cents.
Municipal ...	78	4.2	51	4.6	129	4.40
Companies .	34	4.18	18	4.12	52	5.50

Taking the returns for eight years, with the exception of the first year, municipal stations show much lower costs all round than those of companies, the average of all the returns available being 5.50 cents per 1,000 watt hour, as against 6.6 cents, a saving of 1.1 cents per kilowatt hour.

Alternating current plants run by local authorities show an increased cost of production per kilowatt hour over direct current in the proportion of 6.2 cents to 4.8 cents, a difference of 1.4 cents in favor of direct current. In the case of company stations, both systems show the same results. By grouping all the returns together, a balance of 0.70 cents per kilowatt hour in favor of direct current is observed.

With a view to seeing how far it is possible to reduce the cost of production, without assuming any radical change in the present methods of generation, the following imaginary cost sheets are given. The first is obtained by taking the absolute lowest ascertained cost of each item, and combining same. The result is a total cost of 1.9 cents per kilowatt hour. The second table is one which is more likely to obtain in practice, and is made by taking the average of the ten lowest costs in each item and this gives a total of 2.83 cents per kilowatt hour.

TABLE I.—MINIMUM COST PER KILOWATT HOUR.

	Cents.	Cents.
St. Helen's—Coal	.52	
Oldham—Stores	.04	
Bradford—Wages	.18	
Ealing—Repairs	.14	
		.88
Nottingham—Rent, etc	.04	
Stockport—Salaries, etc	.16	
		.20
		1.08
Bootle—Interest	.44	
Shoreditch—Sinking fund	.38	
		.82
		1.90

TABLE 2.—AVERAGE MINIMUM COST (AT 10 STATIONS) PER KILOWATT HOUR.

	Cents.	Cents.
Coal	.68	
Stores	.06	
Wages	.30	
Repairs	.18	
		1.22
Rent, etc.	.06	
Salaries, etc.	.26	
		.32
Interest	.84	
Sinking fund	.44	
		1.28
		2.82

the list of forty lowest costs. Turning next to the influence of "load factor," it is seen that there are only twenty-three appearing in the table giving the best results; and finally, the importance of low fuel costs is shown by the fact that out of about forty best returns twenty-nine appear in the list of lowest total costs. All these figures tend to show that no single favorable factor is in itself sufficient to command success.

Referring to the average price per kilowatt hour obtained for private supply for the years 1896-1901, inclusive, it must be noted that during these six years, the companies have reduced their average charge from 12.02 cents to 9.92 cents, a difference of 2.1 cents per kilowatt hour; while the municipalities although starting at the lower level of 10.76 cents, have been able to reduce their charges by a still greater amount of 2.22 cents, bringing down the price to 8.54 cents.

No.	OUTPUT.		LOAD FACTOR.		FUEL COSTS.		TOTAL COSTS.	
	Town.	1,000 Watt Hrs.	Town.	Per Cent.	Town.	Per 1,000 Watt hour. Cents.	Town.	Per 1,000 Watt hour. Cents.
1	Liverpool	20,018,142	Bootle	29.42	Accrington	.32	Bolton	1.92
2	Manchester	10,502,299	Liverpool	24.23	Monmouth	.38	Bradford	2c.
3	Glasgow	9,282,044	Stepney	22.74	St. Helen's	.52	Liverpool	2c.
4	Edinburgh	7,760,807	Shoreditch	21.29	Leeds	.54	Nottingham	2.62
5	Bradford	4,901,172	Leith	19.79	Wakefield	.64	Leeds	2.08
6	Brighton	4,860,480	Rathmines	19.16	Edinburgh	.68	St. Helen's	2.08
7	St. Pancras (London)	4,729,840	Ayr	18.31	Leigh	.70	Edinburgh	2.14
8	Nottingham	4,094,807	Wimbledon	18.05	Glasgow	.72	Bootle	2.18
9	Birmingham	3,391,069	St. Helen's	17.84	Burton	.76	Stepney	2.46
10	Bolton	3,120,709	Bolton	17.81	Bradford	.78	Southport	2.46
11	Leeds	3,055,165	Ashton-under-Lyne	17.11	Burnley	.80	Leith	2.48
12	Bristol	2,756,624	Monmouth	16.88	Manchester	.82	Glasgow	2.54
13	Shoreditch	2,734,613	Pembroke	16 77	Govan	.84	South Shields	2.58
14	Halifax	2,557,548	St. Pancras	16.55	Bolton	.88	Sheffield	2.62
15	Sheffield	2,487,584	Sunderland	16.54	South Shields	.88	Darwen	2.68
16	Sunderland	2,375,557	Halifax	16.40	Wigan	.90	Crewe	2.74
17	Islington	2,186,044	Blackburn	16.28	Motherwell	.92	Dundee	2.74
18	Hampstead	2,127,173	Barking Town	16.00	Nottingham	.92	Motherwell	2.90
19	Blackpool	2,018,132	Stafford	15.94	Sheffield	.92	Halifax	2.94
20	Blackburn	2,002,141	King's Lynn	15.58	Dundee	96	Blackburn	2.96
21	Dundee	1,859,943	Bradford	15.57	Halifax	.96	Ashton-under-Lyne	2.96
22	Portsmouth	1,847,790	Brighton	15.56	Swansea	.96	Sunderland	2.98
23	Croydon	1,810,387	Leyton	15.01	Bury	.98	Aberdeen	3.02
24	West Ham	1,583,421	Aberdeen	14 92	Southport	.98	Ayr	3.10
25	Aberdeen	1,546,569	Edinburgh	14.75	Stepney	1c.	Huddersfield	3.16
26	Hull	1,490,099	South Shields	14.67	Liverpool	1c.	Chester	3.18
27	Southport	1,462,407	Wigan	14.61	Newport, Mon.	1c.	Govan	3.24
28	Hammersmith	1,461,427	Govan	14.60	Huddersfield	1.2	Leicester	3.26
29	Southampton	1,430,222	Ealing	14.52	Nelson	1 6	Stockport	3.28
30	Bootle	1,327,432	Crewe	14.47	Leicester	1.10	Wakefield	3.30
31	St. Helen's	1,237,965	Bedford	14.36	Leith	1.10	Leigh	3.32
32	Belfast	1,206,609	Southampton	14.28	Chester	1.12	Wigan	3.36
33	Huddersfield	1,179,849	Southwark	14.23	Darlington	1.14	Cheltenham	3.38
34	Derby	1,081,487	Southport	14.22	St. Anne's	1.14	Manchester	3.38
35	Leicester	1,042,302	Hammersmith	14.20	Gloucester	1.16	Burnley	3.40
36	Oldham	1,042,055	Blackpool	14.18	Lincoln	1.16	Swansea	3.42
37	Stepney	1,008,037	Chester	14.14	Bootle	1.18	Brighton	3.44
38	Cardiff	1,006,763	Harrogate	14.08	Crewe	1.18	Tynemouth	3.48
39	South Shields	985,646	Worcester	14.06	King's Lynn	1.18	Worcester	3.48
40	Ashton-under-Lyne	977,044	Croydon	14.04	Dewsbury	1.20	King's Lynn	3.50

In connection with the cost of production, there are many factors which have an important bearing upon this, but the three which are usually considered to have the greatest influence on costs are output, load factor, and cost of fuel. In order to see how this works out in actual practice, four tables have been prepared. The first one consists of the forty stations having the largest output. The second gives the forty stations with the highest load factor. The third shows the forty stations with the lowest costs per kilowatt hour for fuel, and the fourth gives the forty stations with the lowest total costs per kilowatt hour. Referring first to the influences of "output" on costs, out of the forty stations with the highest "output," only twenty-four appear in

It will be noticed that, taking the last year's returns available, viz., 1901, that no less than 50 per cent. of the companies are obtaining 10 cents per 1,000 watt hour and over for their current, whilst in the case of the municipalities only 19½ per cent. obtain such a large rate of revenue. This is an important point to notice, as municipalities are often twitted with showing a very poor return on the capital expended. They can at least point to the fact that they are supplying their consumers at a much lower rate than is the case with private companies. Had the municipal stations charged the same rate as the companies, they would have enjoyed an increased revenue during 1901 of no less than $2,222,595, equal to 2.62 per cent. on the capital invested.

Average Price Obtained per 1,000 Watt Hour for Private Supply in Great Britain.

	Companies.								Municipalities.							
Year.	14c. and over.	12c. and under 14.	10c. and under 12.	8c. and under 10.	6c. and under 8.	4c. and under 6.	Total Stations.	Average price obtained.	14c. and over.	12c. and under 14.	[illegible]	[illegible]	6c. and under 8.	4c. [illegible]	[illegible]	[illegible]
1896	6	11	12	5			34	14.02		[illegible]	[illegible]	[illegible]	2		[illegible]	
1897	6	14	10	9			39	11.86		6	24	[illegible]	7		[illegible]	
1898	3	15	11	8	1		38	11.48		1	21	[illegible]	11	1	[illegible]	
1899	2	6	19	10	3		40	10.50	1	1	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]
1900		7	20	15	5	1	48	10.04	1	4	[illegible]	[illegible]	[illegible]	3	97	[illegible]
1901	1	3	20	17	6	1	48	9.92		1	[illegible]	[illegible]	[illegible]	7	[illegible]	[illegible]

MACHINE SHOP NOTES FROM THE STATES.

BY CHAS. S. GINGRICH, M.E.—LETTER NO. 2.

One of the common sights in an engine manufactory is a row of engine beds mounted crosswise on the platen of a large planer for the operation of planing the crank shaft bearings. Even small gas engine frames require a large planer, so that the work may pass between the housings,

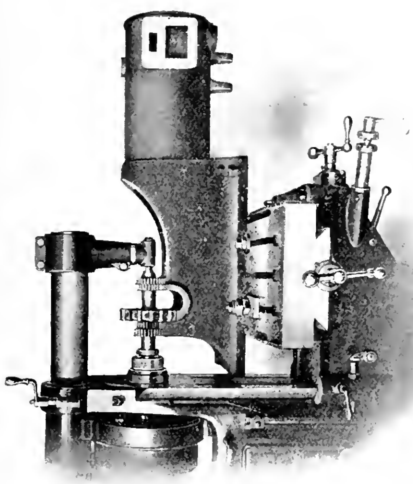


Fig. 1.

and such a planer is invariably a great deal larger than the size of the cut to be taken would warrant. We are so accustomed to doing the work in this way, that we accept it as a matter of course, and forget how awkward a job it really is, until we see someone handling it in a great deal more simple manner. That was the writer's experience when, after having seen a well-known engine builder plane

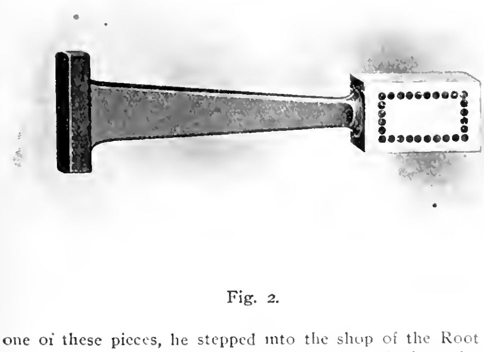


Fig. 2.

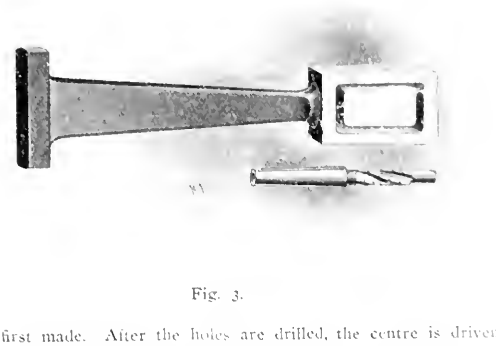


Fig. 3.

one of these pieces, he stepped into the shop of the Root & Vandervoort Engineering Co., East Moline, Illinois, and saw them milling the crank shaft bearing on gas engine frames up to and including their 8-h.p. engines in the manner shown on illustration herewith. The engine frame is strapped to the planer of the miller in just as simple a manner as it would be strapped to the [illegible] for the crank shaft boxes [illegible] cut, using a suitable gang [illegible].

The machine is worked at a feed of [illegible] per turn of cutter when the large cutter is entering the work. After it has entered full depth, the feed is dropped [illegible] to about 3 ft. 32 in., and is again raised to the initial rate when the large cutter begins to come through. This is accomplished by the convenient arrangement of feed levers on this particular miller, whereby the rate of feed can be changed without stopping the machine; no matter how fast the cutters are turning; or how heavy a cut is being taken. The mechanism is positive, and there are no feed belts to shift. The distance travelled at the fast rate of feed about equals the distance travelled at the slow rate, so that the average rate of feed for the entire cut is nearly 15 per cent. faster than it would be if the feed were not changed to suit the cut when the work is passing through the machine.

I mention these details, because it is close attention to these little things that enables the twelve-and-a-half-cent-an-hour boy who operates the milling machine, to finish one of these engine frames in 28 minutes, which includes the time of handling and chucking the work. The shortest time in which an expert planer hand did this same work was one hour and thirty-five minutes.

The caps to fit these frames are milled on the same machine by using another suitable gang of cutters, and we are assured by Mr. Vandervoort that the saving effected is not all in the actual finishing of these pieces, but that the vise work, which was formerly required in order to fit the pieces after they came off the planer, is now done away with entirely, and the parts are all completely interchangeable.

A large number of other parts of the engine, such as brackets and pedestals, are being milled very economically. In some of the shops that build engines using the solid end type of connecting rod, the milling machine is coming into use for finishing these also. Fig. 2 shows one of these rods with a series of holes drilled along the line of the rectangular hole into which the brasses are to be fitted. This is the method that has been in use ever since this style of rod was first made. After the holes are drilled, the centre is driven out and the hole is finished to a size on a slotter.

Those of us who have gone through this work are pretty sure to fully appreciate just how tedious and expensive is this drilling and slotting process. In the shops of the Gray & Blaisdell Co., Bradford, Pa., and the Contractors' Plant

Mfg. Co., Buffalo, N.Y., we have seen this work performed on a milling machine similar to the one mentioned above. We are informed that the Cincinnati Milling Machine Co., have fitted up machines to do this same work for H. Bollinckx, Brussels. A single hole is drilled at one corner of the rectangular into which the brasses fit, and a cutter like that shown in Fig. 3 is passed through and removes the stock at a single cut, as shown in illustration. A second cut is then taken to finish the hole to size. The rod illustrated is 40-carbon hammered machinery steel 2-in. thick, and the finished hole is 3 by 6-in. with corners ½-in. radius. The total time consumed in milling this rod; from the moment the first cut was started until the finishing cut was completed, was 42½ minutes. Of course in doing this, a good bit depends on the cutter. It must be held firmly in the spindle of the machine and its outer end must be supported in the same manner as a cutter arbor is supported. The chips are also somewhat of a problem, but if a strong stream of oil is delivered to the cutter under pressure, it will keep it clear of chips. This operation brings into play both horizontal and vertical automatic feeds of the miller, and since the feed must be stopped and reversed at the corners, it calls for a machine that has all the levers conveniently located.

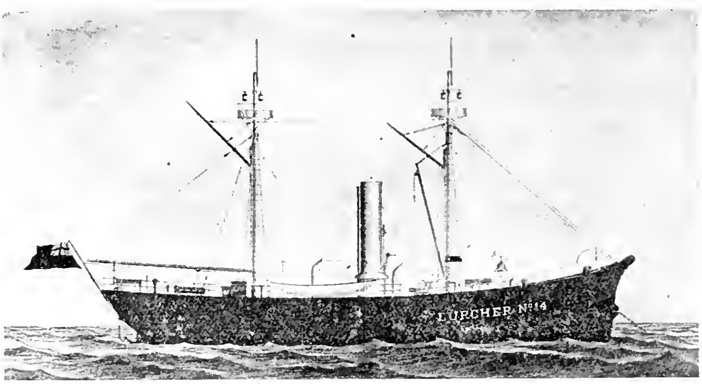
NEW CANADIAN LIGHTSHIPS.

The Polson Iron Works, Toronto, Ont., recently completed and despatched to its destination one of a pair of steel lightships, which it is under contract to build for the Dominion Government. These vessels are the first of their class built in Canada and have a large amount of free-board and are sheered very high in the bows, so as to keep dry when pitching in a heavy sea. They are in excess of Lloyd's requirements for vessels of their size, and have water-tight bulkheads, which will make them almost absolutely unsinkable.

The Lurcher No. 14, which left for its destination just before navigation closed, has a length over all of 124 ft., beam 28 ft., depth from top of keel to spar deck 21 ft. 6 in., draught, fully loaded, 11 ft. 6 in. It has two steel pole spars, on which, 50 feet above the deck, are swung three powerful electric lamps on each spar. The gallery surrounding the lamps serves for a day mark. There is a large automatic fog bell and fog siren worked by compressed air. Fresh water tanks of 60,000 gallons' capacity contain water for drinking and to supply waste in the machinery.

The engine is of the high-pressure, surface-condensing, vertical, marine type, cylinder 23 in. diameter, with 22 in. stroke. Steam is supplied by two navy-type boilers, with a working pressure of 140 lbs. All the pipes are of copper. The vessel will be moored by three mushroom anchors, each weighing 5,000 lbs. The mooring chains are 1⅝-in. stud link, specially made and tested for this work. The ship is furnished with 240 fathoms of this chain, also with 120 fathoms of 1¼-in. stud link chain. The auxiliary outfit is most complete, and comprises steam windlass, capstans, pumps, electric gears, steering gear, etc.; also complete life-saving apparatus constituting it a well-equipped life station. The fittings and furnishings throughout are first-class in all respects and provide everything requisite for the comfort and convenience of the crew.

The Lurcher will be stationed at the Lurcher shoals in the Bay of Fundy, off the Nova Scotia coast. The second light-ship, which will be completed next spring, will be stationed off the island of Anticosti in the Gulf of St. Lawrence.



The Lurcher Lightship.

J. Walter Wells, formerly Provincial Assayer for Ontario, in connection with the Bureau of Mines, has been appointed Chief Assayer for the Dominion Government Assay Office, at Vancouver, B.C. Mr. Wells resigned his position with the Bureau of Mines to investigate the industrial use of low-grade iron ores in Ontario. For this work he was awarded the nomination for the scholarship of the Colonial Exhibition of 1851, at Queen's University, Kingston.

—The ventilation and heating of a theatre presents a problem not easily mastered by the ordinary heating engineer. In a crowded auditorium of this kind ventilation is the all important question. It may be a simple matter to heat the building to a required temperature before the curtain rises, but to maintain a constant temperature and a pure atmosphere while the play progresses is not so easily accomplished. The heat given off from the bodies of the closely seated audience is sufficient to raise the temperature in the house from 5 to 10 degrees during the performance. Fresh air to breathe must be supplied constantly to the occupants and the impure air must be removed. Evidently a system giving forced circulation of air is necessary to meet these requirements. A good example of this system is the recent installation in the New Franklin Square Theatre, at Worcester, Mass. The heating and ventilating apparatus consists of an electrically driven fan and heating coils, located in a corner of the basement. Fresh air is drawn from the outside and circulated through coils of steam pipes enclosed in a fireproof casing and distributed through ducts by means of the fan to the desired parts of the theatre. There are plenum chambers under the orchestra floor and first balcony from which air is admitted through openings in the chair legs giving an even distribution throughout the house. The low velocity with which the air enters prevents annoyance from draughts. The foul air is exhausted through grills in the dome of the theatre and by means of an electric exhaust fan is discharged through the roof. The B. F. Sturtevant Co., of Boston, Mass., were the heating and ventilating engineers, and the apparatus installed is of the Sturtevant manufacture.

The Canadian Engineer

VOL. XI.—No. 3. TORONTO AND MONTREAL, MARCH, 1904. PRICE 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY; MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada, Great Britain and the United States, $1.00 per year, foreign, 6s. Advertising rates on application.

OFFICES—18 Court St. Toronto ; and Fraser Building, Montreal.
Toronto Telephone, Main **4310.** **Montreal Telephone,** Main **2589.**
BIGGAR-SAMUEL, LIMITED, Publishers,

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 15th of the preceding month or if proof is desired, 4 days earlier.

CONTENTS OF THIS NUMBER :

MUNICIPAL OWNERSHIP AT FORT WILLIAM.

The Mayor of Fort William has issued a reply to the special commissioner of the Ottawa Free Press, whose article was published on December 30th last. The Mayor's report not only confirms the statements made in the February Canadian Engineer as to the negative value of evidence opposing municipal ownership of public utilities, but also exposes the methods adopted by corporations to influence public opinion. The Mayor of Fort William states that the "Bell's" special agent, W. C. Scott, was in the town at the same time as the special commissioner; that they stayed at the same hotel; that they returned on the same train; that it is reported on what Mayor Jackson considers good authority that the article was prepared by the two men, on the train, and submitted to the company's head office, before publication. The Mayor in his reply goes on to state that "the city of Ottawa was at that time in the heat of a municipal campaign, in which a by-law for $50,000 for street lighting was before the people, and the mayoralty campaign was based on the question of the city owning its own franchises. The question of the city installing its own system of telephones is also strongly talked in Ottawa. The by-law was carried by 638 majority, and the Mayor, who favored it, was elected by an equally large majority. The Ottawa Free Press was in opposition to both the by-law and the Mayor."

This is on a par with the tactics of the New England Telephone Co. (Bell), which gathered a mass of distorted statistics designed to show that independent telephone companies had been financial failures. These pamphlets have been quietly circulated in Canada, where competition was threatened. The ex-Mayor of Fort William, on a previous occasion, publicly charged the Canadian Bell Company with publishing falsehoods which were inserted in leading papers as news letters, but were in reality paid advertisements. Truly monopolies must have a very weak case if it is necessary to adopt these methods of "educating" the public. These practices, however, cannot have lasting results, for, as has been well said: "You can fool some people all the time, and you may fool all the people sometime, but you cannot fool all the people all the time." It is this feeling on the part of the people that they are being "fooled" by the monopolies that is responsible for the public ownership wave of to-day. If corporations desire to stem the tide they should get down to solid business, get rid of the dropsy, which is becoming a fatal disease with many companies, and give good service in return for rates sufficient to pay fair dividends on legitimate capital. The methods adopted by some companies are not only costly, but in the end ineffective.

The figures supplied by the Mayor of Fort William show that the net result of municipal ownership to end of 1903, is a surplus of $31.86 on the water, electric light, and telephone plants; not a large one it is true, but municipalities aim at supplying service at cost, instead of piling up profits for stockholders. The expenditures include all charges to date, for maintenance, interest and sinking fund, the full amount of the latter being on deposit with the Bank of Montreal. The Free Press commissioner's statement that the chairman of the Fort William Board of Commissioners admitted a large expenditure was necessary to put the waterworks system in shape, has already been publicly denied by the chairman himself as an unqualified falsehood. The commissioner also gives the debenture indebtedness as $437,223, but omits to state that there is a sinking fund in existence of $71,012.64, making the net indebtedness $356,220.54. There are other misleading statements alleged to have been made by the Commissioner, but enough facts have been given to render the whole article valueless, to seekers after truth, in regard to public ownership.

The following extract from the annual address of

the president of the Fort William Board of Trade, last month, affords ample evidence that municipal ownership in Fort William is not the dismal failure which the Free Press commissioner would have us believe. The president says: "The town has now invested in its municipal franchises nearly $400,000, which I am pleased to report have just closed another successful year. The waterworks plant shows a surplus of nearly $2,000 and with the proposed slight increase of rates there is no doubt that the electric light plant will in the future have as good a showing. The telephone system is giving universal satisfaction, and only requires the loyalty of the ratepayers to make it one of the most successful franchises. The battle now being waged around municipal trading by mammoth trusts and greedy monopolies can only have one effect, viz., the awakening of the public to the immense benefits that follow in the train of properly managed municipal ownership of public utilities."

It is also well to bear in mind that even if it could be conclusively proved that municipal ownership had resulted in financial failure in a few cases, it would be no better argument against public ownership than the failure of individual companies, which are of almost daily occurrence, would be against the carrying on of business by private corporations. The fact remains that with an equally efficient staff and capable management a municipality paying only 3½ or 4 per cent. on the actual cost of a system, must in the natural order of things, be able to give service at lower rates than corporations having to earn 8 per cent. on a capitalization which includes nearly 50 per cent. of "water."

PROPOSED BOILER INSPECTION ACT.

In the Ontario Legislature, a bill regarding the "Inspection of Steam Boilers and Steam Threshing Engines" has been introduced by A. G. MacKay, member for North Grey. The motives of the framer of this bill have no doubt been the best, for his desire is evidently to lessen the loss of life from accident, but the ultimate effect of any legislation along the lines proposed may be to increase rather than diminish such loss of life. It will provide safe loop-holes for the clever man—whether maker or user of engines or boilers—who can and will evade the Act, it will shift the responsibility for accidents from the shoulders upon which it should rest and permit those really culpable to escape, and it will prevent many a perfectly competent man from operating agricultural engines. It is not clear, however, whether the Act is limited to agricultural engines, and in this, as in many other respects, it is vague.

Section 5 defines the qualifications of an inspector as one who "must have had such experience in the manufacture of boilers as to enable him to properly perform his duties." He may be utterly ignorant of an engine and how to run it, but so long as he has worked in a boiler shop he would pass. The duties of the inspector are also indefinitely described, and where they are defined they betray a plentiful lack of knowledge on the subject. One of the inspector's duties, for instance, is "to see that the arrangements for delivering the feed water are such that boilers cannot be injured thereby." This is rather hazy. Another duty is to see that a fusible plug is inserted in the crown sheet. As most boilers of this class in Ontario are of the horizontal tubular type, in which the crown sheet is directly over the fire, which would prevent the fusing of the plug till there was no water left in the boiler, it will be seen that the instructions are rather irrelevant to the conditions. So the instructions for keeping the water at a proper level in upright boilers are quite inapplicable to other types, for which there are no regulations whatever. One section provides that in the making of a boiler any person who drifts a rivet hole is liable to a fine of $200, a penalty double that for using a boiler after it has been condemned by the inspector. In other words, a defect which may not affect the safety of a boiler at all, is visited with a penalty twice as great as that of the worst offense possible—that is the use of a boiler that is known to be dangerous. How is the Government to reach an offending boiler maker who is in an Ontario shop today and in Quebec or the United States to-morrow? These are a few only of the weak points in the details of a measure whose first principles are unsound.

Before proceeding further with this measure, we would commend to Mr. MacKay and the Provincial Government a study of the British act dealing with such matters. We have on previous occasions shown how admirably the British act works in practice, simply because, while leaving every man unhampered as to the way in which he will conduct his business, it fixes the responsibility exactly where it belongs. This is common sense as well as justice.

Under the British act the onus of responsibility as regards the condition of a boiler rests upon the boiler owner. He has to see that it is in such a state as not to be a menace either to his employees or to the public. There is no interference on the part of the Government with the owner or user until an explosion takes place when it steps in, holds an investigation, fixes the responsibility of the explosion on the right person—whether the maker, owner or user—and mulcts him in costs. These costs do not relieve the boiler owner or user from his liability at law to his employees. On the contrary, the finding of the Court is considered the basis of an action at law against whomsoever is found at fault.

The law works out in this way: Notice of an explosion, stating the locality, the day and hour, the number of persons injured or killed, the purposes for which the boiler was used, the part of the boiler which failed, and the extent of the failure, must be sent to the Board of Trade [which in Great Britain is a Government department], by the boiler owner or user, within twenty-four hours of the occurrence. A preliminary enquiry is then held, and if the Board sees fit a formal investigation may follow. This enquiry is made by commissioners, one or more of whom must be a competent independent engineer or engineers appointed by the Board of Trade for the purpose of the enquiry only. These commissioners have the power of a court of summary jurisdiction, and the scope of their enquiry can reach back to the time the boiler was built. It covers the boiler owner, the user, the engineer, or others in the employment of the user, the person whom the owner or user has employed to inspect his boiler, a boiler repairer, a second-hand dealer

from whom the boiler may have been bought, or the boiler-maker. Any one of these persons may be found responsible for the explosion. The owner or user is relieved of responsibility by showing that the boiler has been efficiently examined, at proper intervals, by a competent person, and, if any repairs have been recommended, that they have been properly carried out. He is, however, liable for the acts of his servants, and if the engineer were found to blame, the owner or user would be held responsible. A boiler insurance company may be found responsible where its inspector has been negligent in making an inspection, or the commissioners find him to be incompetent. A second-hand dealer may be found to blame for selling a boiler which he knew to be defective, or misleading a purchaser as to its condition. And a boiler maker can be found to blame for improperly making repairs, or where a boiler has been improperly constructed.

When one takes into consideration the fact that this act has been in force for twenty-two years, that there are a far larger number of boilers in use there than in Canada, that the density of the population is far greater, that in comparison the number of boiler explosions is considerably fewer, and the number of persons killed and injured much smaller, there can be no doubt that the British law is founded on common sense and works well in practice. Legislation in Canada could not follow a better model. The Act should be a Dominion and not a Provincial Act, as the machinery required would be adapted to every province, and would be more effective and cheaper by having a single commission of competency, which could not be attained by a multiplication of boards.

THE COMING SYSTEM OF MEASURES.

In another part of this issue will be found Mr. Halsey's reply to the letter of the secretary of the Decimal Association of Great Britain, referring to the continued use of certain old terms of measures in countries using the Metric System. The survival of terms used in special trades might naturally be looked for alongside of the acceptance by the general public of any national system of weights and measures. But while the terms referred to are used in the silk factories, they are not recognized beyond. When the silk merchant puts his goods on the market, he uses the terms of the Metric System. The sailor still takes his soundings in fathoms, but when he goes ashore he finds he cannot buy cloth by the fathom. He must buy by the yard. So with the silk manufacturer; and the survival of a factory custom in a particular trade or place does not diminish the significance of the steady and uninterrupted advance of the Metric System for general purposes over the world. The circumstance that some English terms are still used in the textile trades on the continent merely follows from the predominance hitherto held by British textile manufacturers in the markets of the world, and not because there is any inherent disadvantage in adapting the metric measures to the trade. At the recent international congress, at Paris, held to promote a universal standard of yarn counts, it was agreed by the British representatives that such a universal system should be in metric terms and no other; and Mr. Halsey's present arguments on these points are pretty fully answered in a report published by the American Chamber of Commerce, in Paris, last year on a conference with the Société des Ingénieurs Civils de France. The Chamber, with a view to weighing all objections to the Metric System, submitted thirty questions to the society, and these were answered in detail. Considering the conservatism of British manufacturers, the report of the yarn congress referred to is a striking testimony in favor of the Metric System. We have this report before us and two paragraphs are worth quoting. They are: "The urgent need of the trade is a system of counts which will embrace all classes of yarns, be convenient for the spinner and reeler, and also for the manufacturer, and which will be understood in all countries. 'Count' being the relationship of length to weight it is obvious that such a system could not be attained unless there were one uniform system of weights and measures. The Metric System of weights and measures is so perfect and has been adopted so widely that it forms the most suitable basis for a uniform system of counts of yarns."

Mr. Halsey is struck by the fact that the United States appears to be the strongest fortress of the English system of weights and measures. This is because the United States has, nationally speaking, lived like the oyster, self-contained within its shell, and with comparatively little foreign trade outside of the English-speaking peoples until in recent years. Great Britain lives by her foreign trade, and her past refusal to adopt a system now used by practically all the rest of the world has cost her the loss of millions of pounds. Now she realizes it, and hence the House of Lords has passed the second reading of a bill to render the Metric System compulsory in Great Britain on and from 5th April, 1906. Inasmuch as a majority of the members of the House of Commons have already signed a memorial in favor of the system, there appears to be little doubt that it will pass. Canada and the other colonies will fall into line, because the Premiers of all the colonies at the last Colonial Conference in London, expressed themselves formally in favor of the change. Costly and inconvenient though the change may be for the time being, the gain will be worth the cost, as all Canadians will realize when they compare our present decimal coinage with the old Canadian currency of pounds, shillings and pence.

—The Canadian Telephone and Telegraph Company recently took a number of Ottawa aldermen on a jaunt to the United States to inspect various independent telephone systems. The same company is also offering telephones at reduced rates to aldermen in London, Ont., if they obtain a franchise. While there may be nothing intentionally wrong in either of these acts, they are not worthy of public commendation. If independent telephony is for the benefit of the people, and there is incontestible evidence that it is, companies by avoiding all appearance of evil, in their dealings with aldermen, will stand a better chance of obtaining competitive franchises, and securing the confidence of the people. Any act which indirectly places an alderman under an obligation, however slight, to an applicant for a public franchise, is deserving of the strongest censure.

—The steam turbine may now be accepted as the coming type of marine engine, at least for the larger ships. The Cunard Company recently appointed a special commission of experts to investigate the record of the turbine steamships in use on the English Channel, and this commission has reported that under equal conditions the turbine engines show a saving of 10 per cent. in fuel over triple-expansion reciprocating engines. The new Cunarder that is to be next built will have turbine engines aggregating 60,000-h.p., and this great vessel will fairly inaugurate the turbine era in transatlantic navigation.

* * *

—Anyone who, after reading the official reports of surveyors and explorers in our north country, takes a map of Canada, will be struck by both the commercial and strategic advantages of running a transcontinental railway well to the north. The opinions of Mr. Frood, quoted elsewhere, are confirmed by the high authority of Sir Sandford Fleming, in a pamphlet just issued in support of the Grand Trunk Pacific. Sir Sandford points out that "a second transcontinental railway opens up the alluring prospect of consolidating the Dominion by establishing a great national highway removed from the frontier. This feature of the scheme alone invests the question with special interest to every intelligent and patriotic Canadian." A route such as this, Sir Sandford points out, would save 1,423 statute miles over any existing route from Yokohama to Liverpool. There is not only this saving in distance in connecting Europe with Asia, by way of Canada, but the northerly route gives easier grades which is an advantage of great practical importance in cost of operating. But more important still is the fact that a new Canada will be created in the region to be traversed which could not be developed except by such an arterial line of transportation. Sir Sandford speaks of the arable land making a belt whose northern edge would be 400 miles away from the frontier. We believe this belt of cultivable land will prove to be more than 700 miles broad, measured from any point west of Winnipeg, and that the forest and mineral wealth of the eastern section will also make it pay to keep north through Ontario and Quebec, possibly terminating eventually at a port on the east coast of Newfoundland or on the coast of Labrador, when science has triumphed over the difficulties of navigation in that part of the ocean. It appears to us that, in the light of the success of State-owned railways in India, South Africa and Australia this great highway should be built and owned by the Dominion; but whether owned by the State or not, the work should go on.

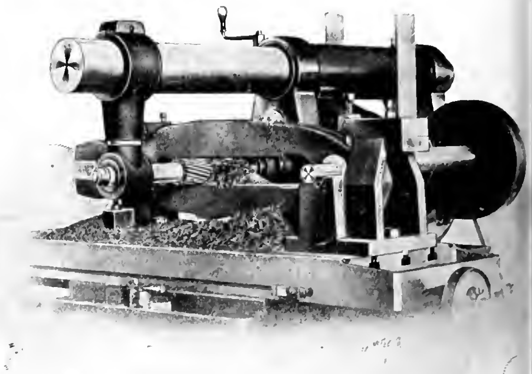
* * *

MACHINE SHOP NOTES FROM THE STATES.

III.

While visiting the machine tool shops, in Cincinnati, recently, I saw the Cincinnati Shaper Co. doing some very interesting things by way of rapid processes of manufacture. These people have just moved into their new shops, and have the best tool equipment that is procurable.

Among the things which I saw, probably the most interesting was the job of milling their rocker arms, which process is made clear by the illustrations herewith. The particular rocker arm photographed is about 36-in. long over all, and about 10-in. wide by 2¾-in. thick. The work is held in the very simple fixtures shown, and the slot is milled to size by using a spiral mill, as shown in Fig 1. The slot in forks at the left hand end is also milled to size in the same manner, as are also the pads at the top and bottom of the main body of the rocker arm. The two sides of the piece are finished by using a 9½-in. diameter face mill to bring the arm to a proper thickness, which is 2¾-in. Then the forked end is



milled by using a gang shown in Fig. 2. All these operations except that of milling the bottom pad and the face of the piece farthest from the body of the machine, are finished without changing the setting. Then the piece is reversed in the fixture and these two surfaces are finished. The job is remarkable because of the simplicity of the fixtures, and the simple way in which the finishing is done.

Although these people make a specialty of building shapers, they find it profitable to finish a large proportion of the parts entering into their product on the Cincinnati

Geared-Feed Miller—the one shown in illustration being one of the half dozen in use. I was told that not very long ago they had been finishing their rocker arms on planing and shaping machines, and in looking over the time cards, we found that they thought they were doing it very well when they got the work done in 14½ hours. They are now milling these pieces by the method which I have just described, in two and one-quarter hours each, which illustrates the saving that can be effected by keeping in close touch with improved tools and methods.

* * *

The Scientific American states that at the Jefferson Ironworks, Ohio, a new composition has been tried which is said to have remarkable effect in welding scrap steel. The scrap is placed layer upon layer, with the composition between, after which heat and mechanical pressure are applied, the result being a homogeneous union of the several parts. A billet of steel thus made was put through the furnace and rolled into a sheet, after which the metal was cut up into smaller pieces, from which nails and washers were made. These were found to be of excellent quality. The cost of making the billet, including the composition and labor, is from 25 to 50 cents per ton.

THE ENGINEERS' CLUB OF TORONTO.

At the meeting of this Club, on February 2nd, J. Alex. Culverwell read a paper on "The Enlarged Erie Canal and Its Relation to Canadian Waterways," reported elsewhere. On February 25th, Captain Killaly Gamble, the new president, delivered his inaugural address, in which he referred to the opening up of the northern portions of Canada by the construction of new railways; the completion of the Pacific cable, which was of great service to the Empire; and the proposed "Trans-Isthmian" Canal. He also pointed out the importance of the boundary lines of our northern limits not being lost sight of. John S. Fielding also read a valuable paper on "Dams," which will be published in a subsequent issue.

LIGHT, HEAT, POWER, ETC.

The electric light plant, at Richibucto, N.B., is completed.

Sydney, C.B., proposes municipal ownership of a gas plant costing $75,000.

Acton, Ont., proposes installing an electric power plant, in conjunction with the present lighting service.

Power is to be generated at Meduxnakeag, two miles from Woodstock, N.B., for the Electric Power Company of that place. C. M. Garden, C.E., has charge of the work.

The light and power service of Winnipeg, Man., comprise 14,194 incandescent, and 66 arc lamps, in addition to its street lighting service, and motors aggregating 654-h.p.

Power is to be developed at Stave Lake, B.C., for electric locomotives to run from Vancouver to New Westminster, and ultimately right through to Seattle on the Great Northern.

The Sherbrooke, Que., Heat, Light and Power Co. have refused the city's offer of $20,000 for the gas plant. They ask $33,000, making the total cost of the electric light and gas plants $233,000.

Westville, N.S., is dissatisfied with its present electric light service, and will ask the Legislature to give the Intercolonial Coal Mining Co. power to light the town instead of the New Glasgow Electric Co.

What is claimed to be the biggest water-pipe in the world is being laid by the Ontario Power Company on the Canadian side of Niagara Falls. It is of steel throughout, one and one-quarter miles in length, and 60 feet in circumference. The plates are half inch, and will require 200 tons of rivets.

The Empire Power Company, of Owen Sound, Ont., has been chartered for the purpose of dealing in electricity for light, heat and power, and developing the same from water power or natural gas. Capital, $500,000. The company includes J. M. Kilbourn, H. B. Smith, G. S. Kilbourn, of Owen Sound, and E. A. Peck, of Peterboro.

In 1901 arbitrators valued the Kingston Electric and Gas plants at $170,373, and said the franchise, which the company claimed was worth $80,000, was valueless. The owners refused to turn the plant over to the city, and a final appeal to the British Privy Council having been dismissed, the city will now secure the plant.

It is proposed to form a merger of the water power interests at the Chaudiere Falls, Ottawa, Ont., for the purpose of economically distributing power to each user in proportion to their holdings. Those interested are the Ottawa Electric Co., the Bronson Co., the Ottawa Investment Co., J. R. Booth, E. B. Eddy, and the Ottawa and Hull Power Companies.

In the article in last issue, headed, "Electricity and Fires," the statistics refer to the whole of the United States and not to Montreal, as stated. The article was reproduced from a Montreal paper whose correctness was assumed. As a matter of fact, only one fire traced to defective wiring was recorded in Montreal during the three months in question.

Millbrook, Ont., is agitating for a supply of light and power, which could be obtained by the rebuilding of the Lockie dam. It is said that enough contracts could be obtained to make the undertaking successful.

Tenders for electric power, for the municipal street lighting, will be received by Ald. Robert Hastey, City Hall, Ottawa, Ont., up to March 15th. A minimum of 350 electric horse-power will be required by May 1st, 1905, with the privilege of increasing to 600 horse-power. The power must be available at all hours, between dusk and daylight, throughout the year. Bonds to the amount of $10,000 will be required from the successful tenderer in addition to $500 deposited when tendering.

At the annual meeting of the Shawinigan Water and Power Co. the treasurer reported that the company was selling in Montreal 6,000-h.p., and at Shawinigan Falls 20,000-h.p.; that the total estimated capacity to be developed was 100,000-h.p. The successful transmission to Montreal had demonstrated the commercial feasibility of transmission within a radius of 100 miles. They had applications for large amounts of power, and anticipated extensive additions to its electrical plant during the present year. The following officers were elected: President, Hon. Robert Mackay; vice-president, J. N. Greenshields; treasurer, J. E. Aldred; directors, Hon. Robert Mackay, Thomas McDougall, Wm. MacKenzie, W. R. Warren, J. N. Greenshields, John Joyce, Denis Murphy, H. H. Melville, J. E. Aldred. It is reported that the company has in contemplation the supplying of power to the large centres of the Eastern Townships, Que.

TELEPHONE AND TELEGRAPH.

The Bell Telephone Company are installing a local system in Lacombe, Alta.

The telephone plant at Victoria, B.C., has been improved recently at a cost of $75,000.

London, Ont., has decided to take no action in the telephone franchise matter until Toronto and Ottawa have settled the question of independent systems.

An order-in-council has been passed granting the British Yukon Railway Co. free right of way for a telephone line from White Horse and Dawson City.

The York County Council, will require the Metropolitan Railway Co. to institute a system of telephones connecting the towns and villages along their line.

Narvik, Norway, the terminus of the world's most northern railway, and within the Arctic circle, has been connected by telephone with Stockholm, Sweden, a distance of 600 miles.

The Mayor of Toronto believes the city should grant a franchise to an independent company, and give them all municipal phones in the City Hall, fire halls, hospitals, etc. This would ensure the success of a new company.

The case of the Bell Telephone Co. vs. Dr. W. W. Birdsall, Fort William, Ont., who ceased using the Bell service, the company claiming another six months' rent under their self-renewing contract, was heard in chambers recently, and dismissed with costs.

In the action of Price vs. The City of Hamilton, to quash the franchise of the Bell Telephone Co., Justice Street has dismissed the application. His Lordship found no grounds for the charge that the franchise law had been secured by corrupt methods. The decision will be appealed.

The Grand Trunk is establishing long-distance telephones on its southern division from St. Thomas to Fort Erie and Niagara Falls, and the middle division from London to Niagara Falls. The telegraph wires are used for the telephone system, without interfering with the telegraph service.

A Swedish engineer, named Orling, has invented in England, in conjunction with the Armstrong firm, a new electric capillary recorder, which will revolutionize the method of telegraphing to great distances. The system permits the placing of twenty-five instruments, side by side, giving the same effect as a single apparatus. A telegram of fifty words can be despatched in ten seconds.

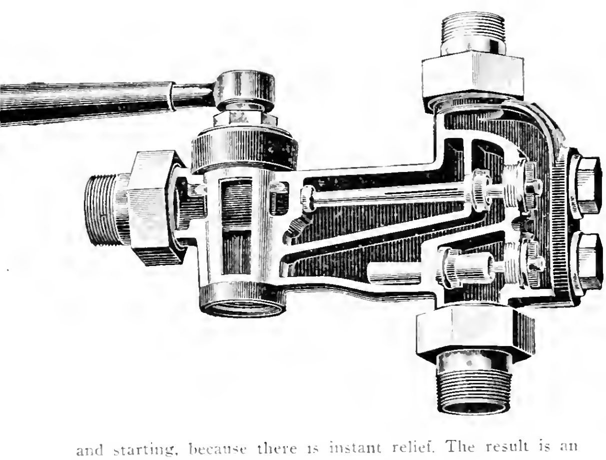
The report of the Bell Telephone Co., of Canada, for 1903 shows: Subscribers added during the year, 8,091. Total instruments earning rental, 57,172. 421 exchanges and 672 agencies. 4,121 miles of wire were added to the Long Distance system in 1903; 1,738 in the Ontario department, 1,260 in the Eastern department, and 1,123 in the North-Western department. The long distance lines now comprise 30,909 miles of wire on 7,085 miles of poles. Total receipts, $2,522,-275. Expenditure, $1,940,123. Net revenue, $582,152. After paying a dividend of 8 per cent., a balance, including surplus for 1902 of $138,078, remained, out of which the following appropriations were made: Insurance reserve, $24,563; accident reserve, $22,979; contingent fund (i.e., depreciation), $50,000. The capital issued is $6,000,000. Bonded indebtedness, $2,000,000.

THE "EASY" DOUBLE TUBE INJECTOR.

This injector is a double tube, positive working machine. Two sets of jets are shown, one being the lifter, and the other the forcer. A positive working cock communicates with all nozzles, and through a simple turning with a handle, opens or closes all connections with the atmosphere and boiler.

Steam is admitted simultaneously to the lifting and forcing steam jets, direct from the boiler. The velocity of the steam passing through the tubes of the lifter and out to the atmosphere, creates a partial vacuum in the water chamber of the lifter, in consequence of which the pressure of the outside atmosphere will force the water into the lifting water chamber. Any excess of steam which cannot find its outlet through the small sectional area of the delivery tube, finds an outlet to the atmosphere, whereby instant relief throughout the length of the tube will be obtained. The velocity of the steam entering the forcing steam jet results in the formation of a partial vacuum; also in the water chamber of the forcer. Therefore, the forcer serves also as a lifter during starting operation.

On account of the lifting power of the forcer, the water discharged by the lifter is simultaneously and automatically taken up by the forcer, even by an entirely open overflow, without necessitating any special construction to secure the entrance of the water into the forcer. The high velocity of steam by higher pressure does not prevent prompt lifting



and starting, because there is instant relief. The result is an instantaneous formation of a current of water and steam to enter into the boiler by the simultaneous and direct admission of steam to both lifter and forcer since no back pressure can exist to prevent the establishment of a working jet. The full or sudden opening of the steam valve cannot have a detrimental effect to the starting of the injector, for the same reason. The sub-dividing of the reliefs for the lifter and forcer makes a sudden closing of the outlet to the atmosphere possible, after the jet is established, without danger of breaking the latter, and, finally, the instant relief and free outlet of the steam from all the tubes makes it possible to start the injector immediately at a full head of steam, on a lift, or under a head of water against any pressure, equal or less than the actuating steam. The whole operation consists in opening the steam valve and turning the handle of the overflow cock in line with the boiler outlet.

This injector will work from 10 to 375 pounds pressure, and higher, without any adjustment of steam or water. The construction of the machine is such that small particles of dirt, etc., are not liable to interfere with its working, and as all tubes are in a straight line, they can readily be cleaned by removing the front nozzles, without disconnecting the injector from its piping.

The inventor of this injector is Francis Sticker, 69 Beekman street, New York. It is now manufactured in Canada by the Canada Foundry Company, Toronto.

MINING MATTERS.

Japan's output of coal in 1901 was 7,428,000 tons, or nearly three times that of 1890.

The White Bear mine, Rossland, B.C., is installing a 20-drill compressor and 350-h.p. motor.

The nitrate mines of Chili last year yielded 1,250,000 tons, on which the Government tax amounted to $21,000,000.

The Dominion Coal Co. contemplate opening new mines in Cape Breton, possibly at Big Glace Bay and Victoria.

The Canadian Commission on electric steel smelting will also investigate the operation of peat plants when in Europe.

A Hendrix electric-cyanide plant for treating ores is being installed at the Mountain Lion mine, near Rossland, B.C.

The large mill of the Canada Corundum Co., at Craigmont, Ont., is completed. Its initial capacity is 300 tons per day.

The Dominion Iron and Steel Co., Sydney, C.B., are erecting a washing plant, with a capacity of 2,000 tons a day, costing $150,000.

What is claimed to be the richest radium bearing earth in the world has been discovered in the Llano gold and coal fields, 115 miles north of Austin, Texas.

The Montreal and Boston Copper Co.'s smelter, at Boundary Falls, B.C., has installed a third furnace and made other preparations for enlarging their capacity.

The Atlin Mining Company, of Ontario, Limited, the British Gold Mining Company, of Ontario, Limited, and the North American Ore Company are to be wound up.

It is announced that Dr. Ludwig Mond's nickel mine, at Victoria, Northern Ontario, has been leased to the International Nickel Company for a year. The mine will be closed, and the smelter used to refine the ore of the iron mine at Massey.

The Rossland Power Co. are erecting a mill for the treatment of ores from the War Eagle and Centre Star mines, Rossland, B.C. The work includes the mill building, 360 by 105 feet, a stone building, 100 by 26 feet, and 700 feet of trestling to carry the railway track over the ore bins, 32 feet high.

J. Obalski, inspector of mines for Quebec, has sent to Prof. Rutherford, of McGill University, a mineral containing radium. Professor Rutherford says the sample contains radium in workable quantity, and compares with the best pitch-blende used for that purpose in Europe. The mineral comes from an old mica mine back of Murray Bay, in Charlevoix County.

The Bridgeport, N.S., colliery of the Dominion Coal Co., which produces coking coal and has an output of 1,000 tons per day, is temporarily closed, owing partly to depression in the United States trade and the reduction of demand in the Canadian market in the winter season. The 600 hands employed will be provided with work elsewhere, as far as possible. A water purifying plant is to be installed at this mine, the first of its kind in the province.

To conserve the Yukon water supply, the Government has approved a plan to impound the surplus water of the spring and rainy season, by the construction of reservoirs in the creeks and gulches, and the storage of water on worked or worn-out ground. Judge Britton and B. T. A. Bell have been empowered to continue the enquiry into hydraulic concessions. Mr. Bell, who was injured by a fall down an elevator shaft, in Ottawa, last month, died on the 1st inst.

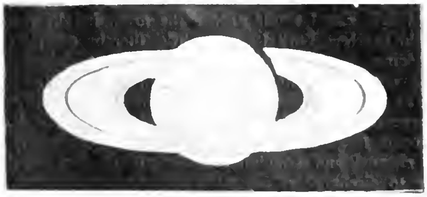
According to an order-in-council, passed at Ottawa last month no more hydraulic mining leases will be granted in the Yukon, and those who now hold such leases will be required to fulfil the conditions.

A syndicate of Canadian and American capitalists, headed by H. M. Whitney, of Boston, has been formed to develop and operate the extensive submarine coal areas at South Head, Port Morien. Extensive purchases of surface lands, water privileges, etc., at Southhead, Port Morien, have been made, and an elaborate survey under the direction of Hiram Donkin, C.E., of the Dominion Coal Company, has been completed. The new collieries, which will constitute the greatest submarine mining project in the world, will resemble the submarine collieries in North Wales, where similar undertakings have been successfully accomplished. C. O. Macdonald, who has investigated the Welsh methods, reports that conditions at Port Morien are more favorable than in British submarine collieries.

PHOTOGRAPHS OF THE MOON AND SATURN BY RADIUM LIGHT.

We believe that to the Rev. Dr. D. B. Marsh, president of the Astronomical Section of the Hamilton Scientific Association, belongs the honor of printing the first photograph taken of a heavenly body by radium light. By the kindness of Dr. Marsh we are able to publish engravings from these two photographs, with the following note as to the method employed:

"I am sending the photographs you have asked for. One is a photograph of the moon, taken by myself, with my own telescope (a 5-inch), and printed from the negative with radium light. Also I enclose a photograph of the planet Saturn, drawn by G. P. Jenkins, F.R.A.S., of Burlington, Ont. Mr. Jenkins drew the planet at the eye of his own telescope in 1895, in Wales, England. The telescope was a 5-inch Wray. From the drawing I have, I [illegible] photograph. And did it (also the one of the moon sent you), in this way. To the negatives I placed sensitive Ilford lantern plates in direct contact. These were put in the holder of my camera. I then took a tube containing 1 grm of



radium of 240 radio-activity, the property of, and kindly sent me by, J. R. Collins, of Toronto. I placed this tube containing the radium inside the camera in the position of the inner lense of the camera. I then drew out the bellows till the radium and plate holder were about 3 inches apart. This being done, I drew the slide and exposed the sensitive plate to the radium light through the negative. The exposure was for 13 hours; the plates being developed, resulted in what I am sending by parcel mail."

THE TRENT VALLEY CANAL.

At the Canadian Institute, Toronto, on February 6th, J. Alexander Culverwell delivered an address on the above subject, which was illustrated by some forty lantern views, showing topographical maps, structures and scenes on the Trent Valley, Soo Canal, Welland-St. Lawrence, the new enlarged Erie Canal, and the Dortmund-Ems German Canal, an interesting description being given of these waterways. Mr. Culverwell argued that the Trent Valley Canal followed out the same method adopted in the $100,000,000 German canal system, connecting the coal and steel districts of Germany with the North Sea, namely, length and breadth of lock rather than depth. It was recognized that by this means, bulk of barge could be accommodated more cheaply, and a cheaper means of transportation afforded. The draught of each system would be eight feet, and the locks of the Trent wider, but not so lengthy. New York State was also building a barge system in the enlarged Erie Canal, which had at present capacity for only 250-ton barges, costing $100,000,000, to accommodate boats of 1,000 tons, 150 feet long, 25 feet wide, and having 10 feet draught. The Trent Valley Canal would accommodate 800-ton boats; the dimensions of the locks were 134 feet long, by 33 feet wide, with 8 feet draught, and the total cost would be only $9,000,000, of which $4,000,000 was already spent on the section between Lake Couchiching—an arm of Lake Simcoe—on the north, and Rice Lake on the south. The balance of $5,000,000, would open up the two outlets, viz., the northern outlet between Midland on Georgian Bay, and Orillia on Lake Simcoe, and the southern outlet between Rice Lake and Lake Ontario, either at Port Hope or Trenton. This waterway would then open up 1,000 miles of inland shore line, many of the lakes and rivers lying transversely to the line of canal.

The speaker explained that the purpose of the Trent Valley Canal was to connect the upper lakes, at Midland, on Georgian Bay, where the great lake carriers would discharge the grain into Trent Valley barges, which, passing through this series of canals and lakes, via Peterboro, where is the greatest lift lock in the world, would enter Lake Ontario either at Port Hope or Trenton, and proceed by the St. Lawrence canals to Montreal, where they would discharge into the ocean carriers for Europe. Only 18 miles out of the 200 miles comprising this waterway, would be actual canal, as compared with the Erie Canal, which had 257 miles of continuous canal, therefore the natural advantages of the Trent system were most apparent. The Trent route would also be 730 miles shorter, between the Soo and Liverpool, than by the Erie, and one day shorter than the Welland route between the Soo and Montreal.

Views were shown of the immense double hydraulic lift-lock, at Peterboro, and the lecturer explained that the five hydraulic locks to be used on the canal would save six hours over the ordinary system of lockage. Views were also shown of similar locks in Europe.

The New York State Commission reported that the enlarged Erie Canal would reduce the grain freight rate from Buffalo to New York by two-thirds, thereby completely underbidding the New York railroad rate possibility. This would demoralize the Canadian grain-carrying trade.

The Dominion Marine Association was clamoring the Government to enlarge the Welland Canal, to enable 6,000-ton boats to pass on to Kingston, making necessary a 21-foot channel, and doubling the length of locks—the idea being to discharge at Kingston into 2,000-ton barges. This request was made just after $40,000,000 had been spent on enlarging that system. The speaker advocated, first, the spending of the five millions necessary to complete the outlets of the Trent Canal, thus giving an international grain route, in addition to water communication, between Peterboro, Lindsay, Orillia and other points with Toronto, Hamilton, and Western Ontario. He pointed out that marine experts writing in American journals have stated that the only Canadian route that they feared was the barge route through the Trent Valley, which, as they express it, was simply a connecting-up of lakes and rivers. In concluding, Mr. Culverwell said that the Trent Valley Canal had obtained a bad name owing to political considerations, but he hoped that a fresh start would be made immediately to complete this great work of utility, and that the public would recognize its true worth in comparison with the modern canal systems of the world.

ROBERT BOWIE OWENS, E.E., M.A., D.SC., F.R.S.C.

Prof. Owens, one of the new members of the Council of the Canadian Society of Civil Engineers, is head of the electrical department of the Applied Science Faculty of McGill University. He is a graduate of Charlotte Hall Military School, Maryland, and special student in physics, mathematics

and electrical enginering in the John Hopkins' University, Baltimore. He afterwards studied at Columbia University, New York, and received from the Columbia School of Mines the degree of E.E. and from the Faculty of Pure Science, same institution, the degree of M.A. He was appointed to the John Tyndall Fellowship for the Encouragement of Research, and twice reappointed. From McGill University, Montreal, he received the degrees of B.Sc. (ad eundem), M.Sc. and D.Sc. He was Professor of Electrical and Steam Engineering, in the University of Nebraska, 1891-1898, and in the latter year accepted the offer of Professorship of Electrical Engineering, McGill University, which he now holds. He has had practical shop experience with the Baxter Motor Co., The Excelsior Electric Co., Westinghouse Electric and Mfg. Co., etc., and has done construction and consulting work in electric lighting, electric railways and power transmission and distribution at various times during the past ten or twelve years. He is an associate member American Society Mechanical Engineers, member and past vice-president American Institute of Electrical Engineers, honorary secretary, for the Dominion of Canada, of the American Institute of Electrical Engineers, member Institution of Electrical Engineers of Great Britain, honorary sec.-treas. for Canada for the Institution of Electrical Engineers, member New York Electrical Society, member and past member of council Society for the Promotion of Engineering Education, president of the Electrical Section of the Canadian Society of Civil Engineers, Fellow of the Royal Society of Canada, member, International Electrical Congress, 1893; member, Jury of Awards, Columbian Exposition; member of Committee of Organization of International Electrical Congress, 1904. Prof. Owens is the author of "Dynamo Design," and of a number of valuable papers and reports to technical societies.

E. H. McHenry, another new member of the Council of the Canadian Society of Civil Engineers, is Chief Engineer of the Canadian Pacific Railway, in succession to P. A. Peterson. Mr. McHenry engaged with the Northern Pacific Railroad Company in the spring of 1883, and successively filled the positions of rodman, chainman, leveller, transitman, resident engineer, locating engineer, assistant engineer, division engineer, principal assistant engineer, chief engineer, and receiver until the termination of the receivership on January 1st, 1897. From that date to September 1st, 1901, he held the position of chief engineer to the reorganized Northern Pacific Railway Company. After a vacation of nine months spent in Oriental travel, he engaged with the Canadian Pacific Railway Company in his present capacity of chief engineer.

THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

At the last ballot of the Canadian Society of Civil Engineers, Montreal, the following were elected members: H. C. Abell, Denver, Col.; R. E. Chambers, Wabana, Nfld.; B. J. Forrest, Inverness, C.B.; J. C. Gwillim, Kingston, Ont.; R. D. Mershon, Montreal. Associate Members—G. B. Ashcroft, A. Balsley, D. E. Blair, W. J. Camp, M. A. Sammett, V. H. Schwabe, all of Montreal; H. S. Badger, Bridgewater, N.S.; J. Causley, Vancouver, B.C.; E. H. Darling, Hamilton, Ont.; F. J. McIntosh and D. A. Ross, Winnipeg, Man.; John Murphy, Ottawa, Ont.; G. E. Revell, Peterboro, Ont.; P. H. Smith, St John, N.B.; W. F. Thompson, Rossland, B.C.; E. T. Wilkie, Carleton Place, Ont. Transferred from Associate Members to Members—R. F. H. Bruce, and P. Weatherbe, Ottawa, Ont.; J. L. Morris, Pembroke, Ont.; H. B. Walkem, Vancouver, B.C. Transferred from Students to Associate Members—R. C. F. Alexander, and J. A. D. Montrouge, Montreal; G. G. Grundy, Rivere du Loup, Que. Associates—C. F. Eicks, F. J. Gilman, and A. Stansfield, Montreal; G. T. Kennedy, Windsor, N.S. Students—M. B. Atkinson, B. O. Bay, W. L. Bird, C. J. Chaplin, W. C. M. Cropper, J. M. Donaldson, W. F. Drysdale, H. K. Dutcher, J. M. A. Gariepy, J. W. G. Greey, F. S. Kaelin, G. K. McDougall, S. G. F. MacDermot, J. McD. McPhee, R. V. Morris, N. W. Parlee, A. S. L. Peaslee, H. B. Pope, A. D. Porcheron, C. C. Richards, A. B. Ritchie, H. G. Rogers, G. W. Scott, G. P. Sharpe, J. C. Smith, S. W. Smith, G. St. George Sproule, R. F. Taylor, J. A. Walls, W. D. Wilson, and F. C. D. Wilkes, all of Montreal; A. B. Blanchard, Parry Sound, Ont.; C. St. G. M. Campbell, Toronto; J. M. Campbell, Port Hastings, C.B.; J. H. Congden, Dartmouth, N.S.; H. C. Kennedy, Hawkesbury, Ont.; J. D. Lachapelle, Sorel, Que.; D. H. Nelles, Grimsby, Ont.; J. E. L. St. J. O'Connor, Parkbeg, Assa.; J. F. Robertson, Jr., Charlottetown, P.E.I.; J. Sears, Kingston, Ont.; A. L. Sharpe, Summerside, P.E.I.; M. H. Sullivan, Ottawa, Ont.

The following meetings were held by this society in February: On the 18th, in the Electrical Section, a paper entitled, "Some Problems in Storage Battery Engineering," was read by Dr. W. E. Winship, of New York. On the 25th in the Mining Section, short illustrated papers on "Iron Mining in the Lake Superior District" were given by H. W. Parlee and C. Campbell, followed by further illustrated matter and discussion.

THE FAIRBANKS COMPANY.

Probably no enterprise in Canada is of more widespread interest to engineers than that of The Fairbanks Company. Certainly no business has made more rapid progress or extended its trade over a larger area in the short period which has elapsed since it entered the Canadian field. The chief offices, warehouse, and salesrooms in Montreal were established in 1898, and since that date branches have been opened in Toronto, Ont.; Winnipeg, Man.; and Vancouver, B.C.

The Montreal premises, situated at Nos. 747 and 749 Craig St., are handsome and commodious, the floor space aggregating 24,000 square feet; The continued increase in the volume of the business, however, necessitates enlarged accommodation, and the company is now negotiating for further extensions. The showrooms rank among the finest in the city, and contain a varied and heavy stock of the numerous products of the company.

most up-to-date methods, thus securing [illegible] world's leader in its particular branch of industry [illegible] concern in the world manufactures a greater [illegible] than this company, comprising, as they do, [illegible] weights used in any part of the world, and [illegible] the standard weights of any country.

A specialty, which the company has found to be [illegible] important line, is the manufacture of its patent renewable asbestos disc valves, which have been installed in most of the large and important buildings in New York City, and the principal American, Canadian, and European centres. Other specialties handled by the Fairbanks Company include trucks in all sizes, shapes and styles, baggage barrows, depot express wagons, push carts, Cole's patent "Coronet" belting, portable forges, gas and gasolene engines, and machinery and tools of every description. They also carry the largest and most complete stock of pulp and paper mill supplies in Canada, and manufacture special makes of trucks for

The Fairbanks Co.—Montreal Warehouse.

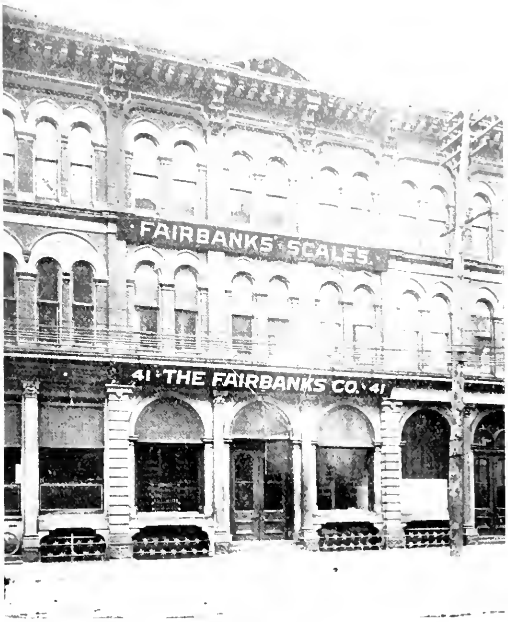
About three-quarters of a century ago, Thaddeus Fairbanks, who owned a woolen and grist mill in St. Johnsbury, Vt., experienced much trouble and loss of time in weighing the wagon loads of merchandise bought and sold by him, there being no other method than that of dividing the goods into parcels or small lots and weighing them separately on an old-fashioned even balance. After much experimenting to devise a machine which would weigh a whole load at a time, his efforts resulted in the invention of what are now the "Standard Platform Scales." They were pretty rough looking propositions, but since that date there has been a progressive development of these scales, and whenever inventive genius or money can devise any improvement, these are at once embodied in "Fairbanks' Standard Scales," in consequence of which they are to-day recognized as the standard —being what their name implies.

Famous for the manufacture of Fairbanks' Standard Scales, asbestos packed cocks, tools and machinery, trucks, portable forges, railway and mill supplies, the Fairbanks Company has secured, and is constantly acquiring, new patents and inventions, for the improvement of its manufactures, enabling it to maintain the highest standards and the

handling paper in rolls, as well as ream paper and pulp. They also carry a full line of tools and other requisites for paper and pulp mills, such as paper scales, micrometer calipers, speed indicators, etc., etc. Their mill supply and valve catalogue is the most complete in Canada, and may be obtained on application by any interested readers.

In addition to goods of their own manufacture, The Fairbanks Co., in Canada, handle the products of the following firms, and in many cases are their sole agents in the Dominion; American Spiral Pipe Works, Chicago, Ill., hydraulic and exhaust steam pipe, galvanized and asphalt coated standard fittings, etc. American Steam Gauge and Valve Mfg. Co., Boston, Mass., gauges, indicator whistles, and other steam specialties. American Tool Works Co., Cincinnati, O., builders of lathes, planers, shapers and drills. Edwin E. Bartlett, Boston, Mass., the Greenerd Arbor press. Bignall & Keeler Mfg. Co., Edwardsville, Ill., pipe cutting and threading machines. The Burt Mfg. Co., Akron, O., "Burt" oil filters and "Burt" exhaust heads. The Colburn Machine Tool Co., Franklin, Pa., boring mills. Henry A. Cole, Liverpool, England, coronet belting. F. M. Dart Mfg. Co., Providence, R.I., the Dart patent union coupling. The

Duff Manufacturing Co., Pittsburg, Pa., jacks and track tools. Emmert Mfg. Co., Waynesboro, Pa., vises. Foster Engineering Co., Newark, N.J., pressure regulating valves, etc. Hill Tool Co., Anderson, Ind., tool holders for lathes. H. W. Johns-Manville Co., New York, N.Y., asbestos packing, etc. The Keystone Mfg. Co., Buffalo, N.Y., ratchets, wrenches, drills, etc. The R. K. LeBlond Machine Tool Co., Cincinnati, O., milling machines, etc. J. J. McCabe, New York, N.Y., double spindle lathes. The Merrell Mfg. Co.,



Fairbanks, Toronto.

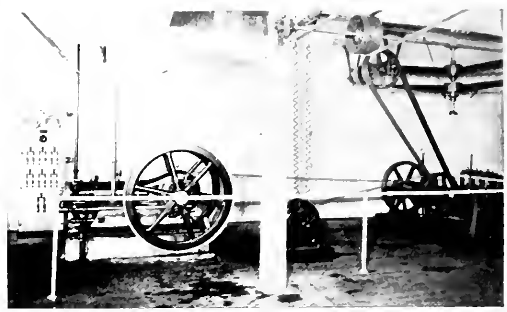
Toledo, O., pipe threading and cutting machinery. The Moran Flexible Joint Co., Louisville, Ky. R. F. Morse, Providence, R.I., gauge glass preservers. National Tube Co., New York, N.Y., iron pipe. New Process Twist Drill Co., Taunton, Mass. Niles-Bement-Pond Co., New York, N.Y., iron working machinery. The Norton Emery Wheel Co., Worcester, Mass. The O.K. Tool Holder Co., Shelton, Conn. The Oneida Steel Split Pulley Co., Oneida, N.Y.

Main Floor, Toronto.

The Oster Mfg. Co., Cleveland, O., pipe tools. The Pratt & Whitney Co., Hartford, Conn., machinists' tools, and machinery. The Reed Mfg. Co., Erie, Pa., vises, pipe wrenches, etc. The Reliance Machine Tool Co., Cleveland, O., bolt cutters. The Reliance Safety Water Column Co., Cleveland, O. The Taunton Locomotive and Mfg. Co., Taunton, Mass., feed water heaters. The Thorpe-Platt Co., New York, N.Y., Geipel steam traps. The Union Chuck Co., New Britain, Conn., lathe chucks. J. H. Williams & Co., Brooklyn, N.Y., drop forgings. Wilmarth-Morman Co., Grand Rapids, Mich., twist drill grinders, and Yale & Towne Mfg. Co., New York, N.Y., chain blocks.

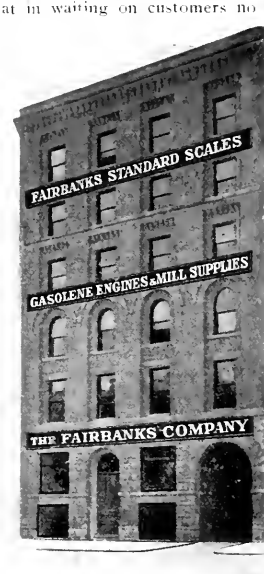
The Fairbanks Company is undoubtedly the largest engineering supply house in the Dominion, and with its various branches carrying, as they do, a stock of goods specially adapted to the needs of the industries peculiar to the districts in which they are located, it is enabled to meet all demands promptly, and with a degree of satisfaction to its customers not surpassed by any other firm in the trade.

In the company's Toronto branch, recently opened at 41 Front St. West., situated in the centre of the wholesale section of the city, no expense has been spared in building suitable fixtures, so that stock can be arranged systematically, and the necessity of unnecessarily handling goods obviated. The warehouse has a frontage of 33-ft. by 198-ft., having four



Fairbanks Gas Engine.

floors. In the basement is installed a very complete engine room, equipped with a 16-h.p. Fairbanks' gas engine to run the scale repair department and lighting plant. The sample warehouse on the first floor has been arranged in departments, the head of each having his samples and catalogues at hand, so that in waiting on customers no time is lost in



The Fairbanks Co.—Winnipeg.

looking through the stock for samples which a buyer may wish to see, these being displayed in their respective departments. The second floor has been devoted entirely to the handling of iron pipe fittings, valves and engineers' brass goods, being fitted up in sections for the various lines covered

by the above goods. The third floor is suitably arranged for scales and transmission appliances. In connection with this warehouse is a very desirable pipe shed located on the railway siding, having rolling doors, so that pipe can be taken off or loaded on cars, whichever the case may be. It is also fitted

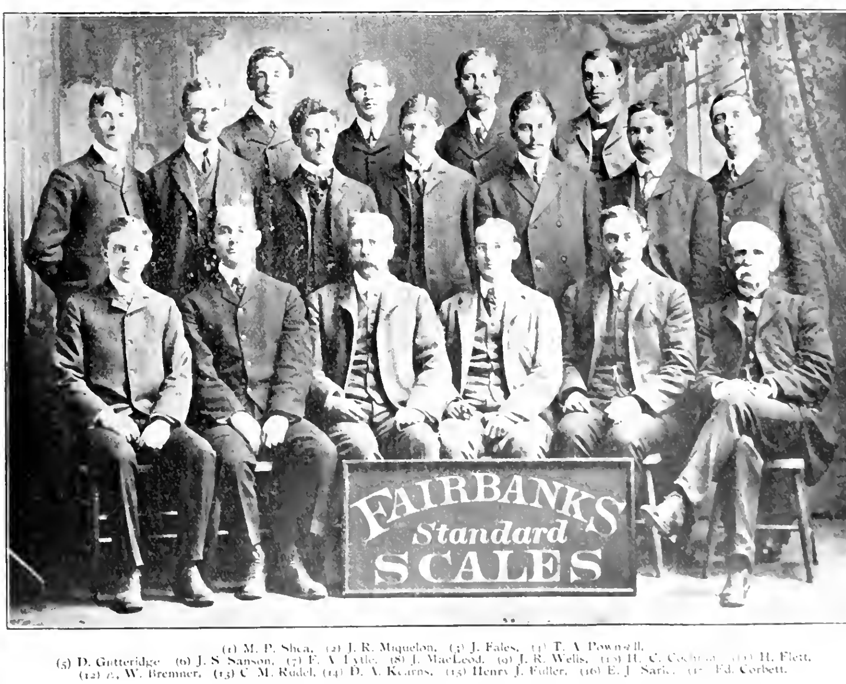
Fairbanks, Vancouver.

with rolling door on the yard side, so that goods can be easily placed on dray for local delivery. The location of the warehouse is such as to give shipping advantages, by rail and water, that very few enjoy, owing to the fact that it is one block from the G.T.R. or C.P.R. freight sheds, and the shipping dock immediately at the back.

shipped in. The r[illegible] ha[illegible] been [illegible] manent accommodation has been secured, and [illegible] warehouse in Arthur [illegible] G. F. [illegible] mill, is stocked with [illegible] complete assortment [illegible]. The warehouse [illegible] 37,[illegible] floors, a 54-ft. frontage [illegible] firm does not own [illegible] built after specifications [illegible] are the biggest in W[illegible] capacity [illegible] tons, and capable of ha[illegible] this firm deals. An [illegible] power being furnished by [illegible]. In addition to a large local staff, four [illegible] the territory between Port Arthur and [illegible] the Edmonton branch.

Fairbanks, Vancouver.

The Vancouver house is located at 153 [illegible] street. The warehouse is particularly well adapted [illegible] handling of heavy machinery and allied lines, has 54 ft. front, 110 ft. deep, and the main floor is on the level with the front sidewalk, while the basement is on a level with the lane in the rear. In this branch is made a specialty of such goods as are particularly adapted for the needs of the trade, principally mines and lumber interests. For the mine interest they represent the Jenckes Machine Co., and Canadian Rand Drill Co., and carry a full line of boilers, engines, air compressors and parts for same. For the lumber trade they carry a full line of S. A. Woods & Co.'s American woodworking machinery, also that manufactured by Cowan & Co., Galt. They also carry a full stock of "Goodhue" belting, being the exclusive agents for British Columbia. The above special lines are in addition to the regular stock of mill and factory supplies handled in common with other houses of The Fairbanks Co., and are fully equipped to meet all requirements of the territory. The Fairbanks Co. is the only concern in British Columbia carrying a stock of iron and brass-working machinery, the demand for which is at present somewhat limited. Of the various branches of the company, no house has brighter prospects at the present time for business than the one at Vancouver. It is in charge of John



(1) M. P. Shea. (2) J. R. Miquelon. (3) J. Fales. (4) T. A. Pownall. (5) D. Gutteridge (6) J. S. Sanson. (7) F. A. Lytle. (8) J. MacLeod. (9) J. R. Wells. (10) H. C. Cochran. (11) H. Flett. (12) R. W. Bremner. (13) C. M. Rudel. (14) D. A. Kearns. (15) Henry J. Fuller. (16) E. J. Saric. (17) Ed. Corbett.

About January 15th, 1903, the company decided to establish in Winnipeg a warehouse, stocked with its own goods, and F. R. Newman was sent from Montreal. Temporary quarters were engaged in Thistle street, and a stock of goods

E. Botterell, formerly of the Montreal house; the office being under the supervision of F. M. Cullen; C. J. Roger has charge of the supply sales department, and W. A. Akhurst, the machinery department.

The accompanying illustrations show the Canadian headquarters in Montreal, also the branches at Toronto, Winnipeg and Vancouver.

The headquarters staff of the company's Canadian business is as follows: Henry J. Fuller, general manager for Canada; D. A. Kearns, cashier; E. J. Sarle, in charge of valve department; C. M. Rudel, in charge of machine tool department; E. Corbett, in charge of transmission department; A W. Bremner, purchasing agent; T. A. Pownall, secretary to manager; J. R. Wells, advertising department, and the following sales staff: D. Gutteridge, A. Fred. Lytle, J. R. Miquelon, J. Fales, M. P. Shea, J. S. Sanson, H. C. Cochran, and H. Flett.

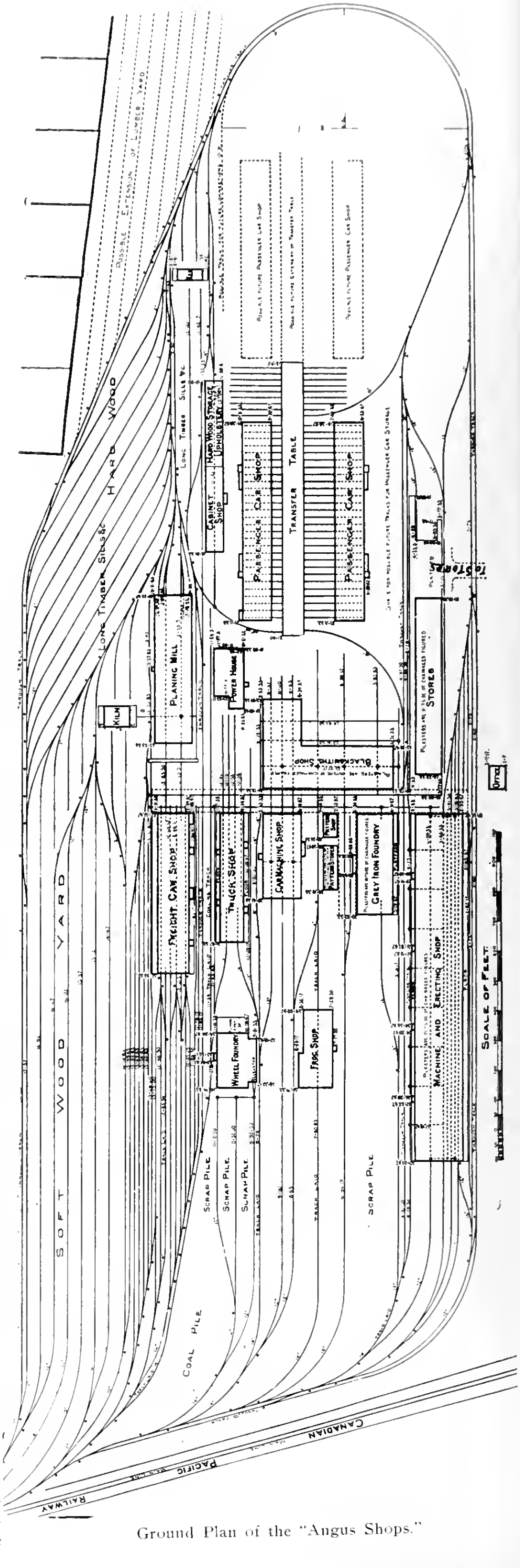
In addition to the Canadian business, The Fairbanks Company have warehouses in New York, Boston, Buffalo, Philadelphia, Baltimore, Pittsburg, Albany, N.Y.; Syracuse, N.Y.; New Orleans, Hartford, Conn., and London, Eng.

The advertisement of the Taunton Locomotive Mfg. Co., of Taunton, Mass., another of the firms represented in Canada by The Fairbanks Co., appears for the first time in this issue. The Wainwright even-flow, feed water heater is one of the specialties made by this company.

THE "ANGUS SHOPS" OF THE CANADIAN PACIFIC RAILWAY.

BY HENRY GOLDMARK, C.E., ENGINEER IN CHARGE OF CONSTRUCTION.

The "Angus Shops" are situated on the Quebec line of the Canadian Pacific Railway, in Hochelaga Ward, Montreal, about two and one-half miles from the Place Viger Station. The site is a plateau with an average elevation of about 127 feet above sea level. It is very nearly level, having a general slope of about one-tenth of one per cent. towards the river. The property is a rectangular plot about 4,700 feet long and 2,000 feet wide, its longer axis running north-east and south-west. The connection of the shop tracks with the main line railway is at the north-west corner, the steep gradient of the road making any other connection impracticable. Although the contour of the ground is favorable and the necessary grading comparatively moderate in amount, much expense had to be incurred in order to procure safe foundations. This was due to the fact that the solid rock bottom is from 8 to 20 feet below the ground line (except in the case of one or two shops), while the blue clay overlying the same is altogether too soft to support the foundations of the buildings. The increased expense involved in these extra foundations was nearly $80,000. In a few cases ordinary piles, capped with concrete, were used, but almost all the important shops are built on what may be called a dry wall foundation. For each wall a trench 3 to 4 feet wide was excavated to bed rock and fitted to a level of five feet below the ground with large, flat quarry stones, laid dry. On this sub-foundation the ordinary masonry walls were reared. As the ground was thoroughly saturated with water, this work was expensive and tedious. It is believed, however, that on the whole this was the most economical and suitable foundation that could be used. This was specially the case as the stone for these foundations, and likewise for all rubble and concrete work, was taken from a limestone quarry on the shop grounds about one-quarter of a mile from the buildings. Near the freight car shop an outcrop of the hard trap rock locally known as Banc-rouge, involved about 8,000 cubic yards of rock excavation. It may be added that the eastern portion was wooded and had to be cleared, while a part of the central portion was swampy, requiring a moderate amount of gravel filling. For surface drainage several open ditches 4 to 5 feet wide were built, but these also drain territory belonging to other owners north of the shop grounds. The surface drainage of the central part of the ground will go into sewers referred to later in this paper, which connect with the city system. The main purpose of the shop's sewers is, however, the carrying off of wastes. The Angus shops are intended primarily for the maintenance and repairs of the rolling stock in use on the eastern half of the transcontinental railway. In addition to this, provision has been made



Ground Plan of the "Angus Shops."

for the construction of a considerable number of new locomotives, passenger and freight cars. Besides this, a separate building is devoted to the manufacture of frogs and switches, while the machine shop and the foundry will turn out many miscellaneous articles required in operating the railway and in new construction. The general stores are to serve the entire system, while the general offices will serve as headquarters for the superintendent of rolling stock, master car builder, and general storekeeper. The shops naturally fall into three classes, the first those devoted exclusively to car work, the second to locomotive construction and repair, and the third being common to both departments. The first class comprises the planing mill and cabinet shop, the passenger car shops, freight car shops, truck shops, and car machine shop, as well as the wheel foundry and the dry kilns. Locomotive work is concentrated in the large locomotive, machine and erecting shop, while the blacksmith shop and grey iron foundry (with its pattern shop and storage building), serve for car work as well as engine construction.

The arrangement of the buildings, with reference to one another, and the best methods of moving the material within the shop's grounds, was of the first importance and became the subject of extended investigation. It was influenced largely by the shape of the property, the position of the main line tracks as well as the ground available for storage. The future enlargement of the shops had also to be considered. Every building is in fact so arranged as to allow future enlargement, while suitable locations have been reserved for additional buildings.

The main point to be considered in the arrangement was, however, the economical and direct handling of the material from the raw state to its incorporation into the finished car or engine. The general layout may be called a combination of the longitudinal and transverse system. The tracks running parallel to the buildings and to the long axis of the shop's grounds form the principal means of access. As may be seen by reference to the plan, most of the buildings are prepared along a traverse avenue, 80 feet wide. On this avenue, popularly called the Midway, the usual transfer table is discarded in favor of a 10-ton overhead electric travelling crane, running on structural steel supports over 1,000 feet long. It is believed that this crane will prove a most valuable adjunct in handling material between the different shops. It is supplemented by a surface track with turntables on the Midway. A similar outdoor crane serves the stock-yard adjacent to the grey iron foundry.

The different classes of work may be briefly indicated. The building of freight cars is one of the most important functions the shops will have to fulfil. A large and increasing number are a necessity to the road, while the existing facilities in Canada are meagre, and the prevailing duty makes importation from the United States expensive, besides being opposed to the policy of the railway to have all possible work done within the Dominion. The proposed output is twenty-five to thirty cars per day, requiring in the aggregate a very large amount of lumber and iron. The large wood storage ground indicated will probably prove scanty rather than too liberal. This lumber will all pass through the planing mill, though a large proportion of it must first be dried in the larger softwood kiln. The finished timbers emerge from the west end of the mill and pass on to the freight car shop, a small transfer table assisting the movement. The iron work for freight cars is forged in the blacksmith shop or cast in the grey iron foundry and machined in the car machine shop, whence it goes to the truck shop or the freight car shop for final use. In the truck shop the trucks for the freight cars, as well as for the coaches are put together. The chilled wheels are to be cast in the well-equipped wheel foundry with a capacity of 300 wheels per day; they are bored and pressed on the axles in the west end of the truck shop, which is provided with all necessary machinery for this purpose. The completed truck goes to the freight car shop where the car bodies are erected on it. There are four tracks for erection purposes each 540 feet long and two intermediate tracks for bringing in supplies. Six travelling cranes fitted with air hoists will handle the heavier material. The material for the passenger car shops is prepared in the mill and the cabinet shop, the mahogany and other hardwood being dried in the smaller kiln and stored in the hardwood storage, which forms the first floor of the upholstery shop. The coach shops are served by an electric transfer table 75 feet long, operated through an overhead trolley by a 20-h.p. alternating current motor. The coach shops are 100 feet wide, each shop has 28 tracks spaced 24 feet apart, centre to centre.

The locomotive shop is of the longitudinal type with three bays, each 1,165 feet long, of which 300 feet is devoted to the boiler and tank work. There are three bays, the erecting bay, which is 80 feet wide, and adjacent machine shop bay 50 feet wide, and a third bay 25 feet wide, with an overhead gallery of the same width to be used for lighter machinery. In the erecting shop there are three tracks with pits and two intermediate supply tracks. The engines are handled by two 60-ton electric travelling cranes each having a 10-ton auxiliary hoist. In the boiler shop there is a 20-ton travelling crane on the same runaway and numerous jib cranes. In the machine shop there is one 15-ton and one 10-ton crane of 50 feet span. All these cranes are driven by continuous current motors the voltage being 250. Besides this, the boiler shop has a hydraulic crane in the riveting tower to serve the riveter. In the designing of the building, adaptation to their respective uses and economy in both first cost and maintenance were the prime considerations. It is hoped, however, that the appearance of the buildings is not objectionable, though perhaps not æsthetically pleasing. Some care was indeed taken to avoid disfiguring construction. Among the principal requirements to be met in the construction, we may mention the necessity for good lighting in all parts of the buildings, and in all weathers; to ensure this the brick walls are pierced with as much window surface as possible without endangering their safety. Steel frame construction for the side walls was, however, not used, the walls being self-supported and also carrying the trusses, except in the south wall of the locomotive shop. The windows occupy about 50 per cent. of the wall surface. In addition to this, almost all the buildings have skylights; these generally run transversely, extending half the width of the building. As there is a skylight in every bay and its width is half the width of the bay, the skylight area is about 25 per cent. of the roof area. These skylights are of galvanized iron framing and covered with three-eighths rough-cast glass laid in putty. The panes are 2 feet wide and in one piece for each half-skylight, avoiding all joints in the glass. A revolving ventilator is generally fitted to each skylight. Another important requirement was a greatest possible safety against destruction by fire, consistent with reasonable economy. The buildings are all of a simply strong construction in conformity with the the rules for slow burning mill construction, as developed by the Massachusetts mill burners mutual insurance companies. The walls are of hard burned brick laid in Portland cement mortar. They are from 12 to 16 inches thick with pilasters about 20 feet apart. In the arrangement of the roof-framing and the spacing of the supporting columns, the demand of the operating department with regard to the layout of the machinery had to be considered, and the result is in some cases a compromise between their requirements and economy in construction. It is believed, however, that as built, no important requirement in the use of the shop has been sacrificed. The framing of the roof is of three kinds, first a column and girder construction (usually in timber), as in the truck shop and frog shop, the passenger car shops and the cabinet shop. Second, a roof frame consisting of Howe trusses, supported on steel columns, as in the freight car shop planing mill and car machine shop. Lastly, heavy steel columns and trusses are used in the locomotive shop, the foundries and the blacksmith shop.

(To be continued.)

* * *

The two Curtis steam turbines generator units of 2,500-h.p. each, recently ordered from the Canadian General Electric Co., Peterboro, Ont., by the Toronto Electric Light Co., are now under construction.

INDUSTRIAL NOTES.

The Davis Tanning Co. will erect a $40,000 plant at Newmarket, Ont.

The Anderson Furniture Co. propose erecting a factory at North Bay, Ont.

The Arnprior Roller Mills have installed two new American turbine wheels.

The addition to the malleable iron foundry of the Martin Co.'s saddlery hardware works, Whitby, is about completed.

A. B. Jardine & Co., Hespeler, Ont. are making shipments of blacksmith's tools to New Zealand and New South Wales.

The Brewster Manufacturing Co. has been formed at Edmonton, N.W.T., to manufacture the Brewster patent tubular fanning mill.

Lacombe, Alta., have recently purchased from the Waterous Engine Works Co., a complete fire equipment, including a gasoline fire engine.

W. Craddock, of Ontario, and J. W. Singleton, London, Eng., propose erecting a wood-working factory at Woodstock, N.B. $50,000 will be invested.

The corporation of St. Johns, Que., have given an order to T. A. Morrison & Co., of Montreal, for a portable Champion stone crushing plant and steam roller.

Almon Reid, Foxboro, and Geo. A. Labey, Frankford, have purchased the Downes' water power at Deer River, Marmora, Ont., and will manufacture staves, heading, etc.

The Edwardsburg Starch Works, Cardinal, Ont., have acquired the plant of the Cardinal Manufacturing Co., and will manufacture their own barrels, packing cases, etc.

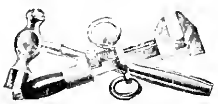
W. D. Bliss has established a mica factory at Smith's Falls, Ont. It is understood that the industry is controlled by the General Electric Co., of Schenectady, N.Y. From 60 to 100 girls are employed.

The Canada Glass Works Co. propose to locate at Sydney., C.B. They will erect plant costing $500,000, and employ 250 to 350 men. Arthur M. Crofton, Sydney, is the secretary.

The rolling mill department of the Toronto Bolt and Forging Co.'s works were temporarily closed last month, as a result of a reduction in wages. The men afterwards returned to work.

The Sydney Cement Co. propose to erect a plant at Sydney, C.B., of a daily capacity of 250 barrels, and employing 200 men. Slag from the Dominion Iron and Steel Co. will be used as a compound.

The Mechanics' Supply Co., of Quebec, are introducing



another attractive novelty, namely, a watch charm, designed as a machinist's hammer. Either this or the small wrench makes a popular watch charm, as mentioned in the advertisement, and they are sold at a low price.

A new agreement has been drafted between the town of Collingwood, Ont., and the Cramp Steel Co., the main features of which are that the company will operate a steel plant, having a daily output of 120 tons, and employing 200 men, continuously for thirty years from June 1st next, and invest $350,000 in the undertaking. The town will give the company 25 acres of land, and $60,000, payable when the plant has been in operation thirty days.

The insolvent Hamilton Motor Works, the assets of which have been purchased, has for several years been carried on in Hamilton, the manufacture of marine and stationary gasoline engines being its specialty. Lack of capital was reported to be the cause of the failure. The business is being reorganized, and a joint stock company formed with the following officers: J. A. Turner, president; W. G. Smart, vice-president; W. A. Logie, secretary-treasurer. These gentlemen are all interested in the Smart-Turner Machine Co. They have a good stock of engines, completed and in process of manufacture, and will be able to supply their customers promptly. The engines turned out by the old firm were generally highly spoken of by purchasers.

The Walkerville, Ont., Wagon Co.'s plant has been sold to a company at West Lorne, and is being removed to that village.

Work will begin this month on the Ottawa University. Instead of one building several will be erected, the main building to be finished this year at a cost of $150,000.

It has been decided not to attempt to reopen the Bailey Cutlery Works, at Brantford, which were recently closed owing to United States competition. The plant has been sold to a Toronto firm.

The Imperial Paper Co., of Sturgeon Falls, which is now turning out 40 to 50 tons of paper per day, contemplates extending its mills to a capacity of 120 tons per day. The extensions will cost about $1,000,000.

The recent Dominion order-in-council for the payment of bounties on articles made from steel, provides that on rolled round wire rods sold to wire manufacturers for use in making wire in their own factories in Canada, the bounty shall be $6 per ton; on rolled angle ties, joists, girders and other rolled shapes of iron, as well as rolled plates, when sold for consumption in Canada only, $3 per ton. The conditions under which the bounties may be claimed will be explained on applying to the Department of Trade and Commerce.

The Canadian Engineering Company has purchased the plant, buildings, and land owned by the late James Cooper, in the neighborhood of Rockfield, near Montreal, for $200,000. The plant was considered the most complete in Canada for the manufacture of mining machinery. R. W. Chaplin, of New York, former manager of the Ingersoll Rock Drill Company, has been appointed manager of the new concern, which will engage in the manufacture of machinery for the Canadian Bullock Electric Mfg. Company and the Ridgewood Hoist and Cable Company.

MARINE NEWS.

Capt. Stanton is building a 90-ft. steamer for Sparrow Lake, Ont.

The contract for the new dock, at Pembroke, Ont., has been awarded to W. J. Poupore, at $44,000.

Mr. Johansen, a Swedish steamship man, proposes to establish a service between Stockholm and Canada.

A steamship line is projected between Vancouver and Dyea to connect with traffic to Dawson City. Capt. McLennan is the promoter.

In 1870, Japan had no modern merchant ships. The mercantile fleet to-day has a tonnage of 1,000,000, and it occupies the seventh place among the world's shipping nations.

Bowring Bros., Limited, have secured the Government contract for the Newfoundland coastal service. English steamers will be chartered until the new boats have been built.

A lighthouse board has been inaugurated by the Government, comprising the Hon. R. Prefontaine, as an ex-officio member; Col. Gordeau, Deputy Minister; Colonel Anderson, Chief Engineer; Capt. Shain, Capt. Salmon and a representative of the shipping interest.

The Canadian Commissioner in Paris reports that the Messrs. Coulombier, of Bordeaux, contractors for the direct steamer service between Canada and France, are now in a position to carry out their agreement with the Dominion Government.

The lightship Lurcher parted her cables on February 15th, and returned to Yarmouth, N.S. Marine men in the Maritime Provinces allege that she is not suitable for her work, and bears evidence of being built by men acquainted only with fresh water requirements. The sketch of this vessel in last issue was from the Marine Review, Cleveland.

Two turbine steamers will run between Toronto and Port Arthur next year. Their capacity will be 242 passengers and 1,000 tons of freight on a 12-foot draft. Length, 250 ft.; beam, 41 ft.; speed, 16 knots. Cost, $250,000 each. The company will include the stockholders of the old Georgian Bay Navigation Co. The round trip will occupy eight days.

Miss B. F. Waring is manager of the Springfield Steamship Company, St. John, N.B. Her company intends putting the steamer Springfield on the Fredericton-Gagetown route when the river opens.

H. H. Gildersleeve, son of the general manager of the Richelieu and Ontario Navigation Co., is now general manager of the Northern Navigation Company, and is engaged in inspecting the fleet and appointing officers for the coming season.

The Reid Newfoundland Company are erecting new machine shops for building marine engines, repairing vessels, and railway work of all kinds, at St. John's. The machines are to be driven electrically, and hydraulic and pneumatic tools will be used in docking and repairing vessels. A building 220 feet long by 45 feet wide will be used for building and painting passenger and freight cars. There will also be a foundry for railway and marine castings. The electric power required to run these shops will be taken from the plant at Pelley Harbor. Heretofore ships could not effect heavy repairs at St. John's, but with the facilities now provided, the work can be effected as promptly and as cheaply as elsewhere. This is the first large machine shop and foundry in Newfoundland.

The report of the Richelieu and Ontario Navigation Co. for 1903 shows that the gross receipts were $1,104,802, an increase of $67,136 over 1902. The operating expenses and fixed charges were $915,169, leaving $189,633 net profit, and after paying a dividend of 6 per cent. $1,712.57 was carried forward. The assets of the company are $3,703,817.50, of which $3,465,712 comprise steamers, real estate, buildings, wharves, etc. The company's bonded indebtedness has been reduced from $571,833 to $404,420. The report also states that the steamer Montreal, which was damaged by fire last March, while in the builders' hands, is being reconstructed at Sorel, and will be ready for the season of 1905. The Carolina, which met with an accident in the Saguenay river, will be repaired in time for the coming season. The construction of a marine railway dry dock at Sorel, Que., is contemplated. The company will exhibit a model of the steamer Kingston at the St. Louis Exhibition. The location adjoins the British Marine exhibition, and near the Egyptian Government exhibit, which will make a special display of Nile boats. Senator Forget has resigned the presidency, and at the annual meeting Rudolphe Forget was elected to that position. George Caverhill was elected chairman of the executive committee, as also were the following directors: L. J. Forget, Wm. Wainwright, R. Forget, F. C. Henshaw, George Caverhill, C. P. Paradis, H. Markland Molson, E. B. Garneau, J. Kerr Osborne, Colonel H. M. Pellatt, and Wm. Hanson.

PERSONAL.

George O. Buchanan, of Kaslo, B.C., has been appointed inspector of lead bounties.

Hiram F. Donkin has been appointed chief engineer for the Dominion Coal Co.

The C.P.R. have appointed S. J. Hungerford superintendent of locomotive works, at Winnipeg.

E. A. James has been promoted from general superintendent to manager of the Canadian Northern Railway.

The C.P.R. have appointed William Cross assistant to the second vice-president, at Winnipeg, with general supervision of all mechanical matters on western lines.

G. J. Bury succeeds J. W. Leonard, as general superintendent of the C.P.R. in the West. Mr. Bury was superintendent of the Lake Superior district. His headquarters will be Winnipeg.

S. S. Dickenson, superintendent at Hazel Hill, N.S., for the Commercial Cable Company, has been appointed general superintendent of the company, with headquarters at New York. Mr. Gerrard, his assistant, succeeds him at Hazel Hill.

C. G. Atwater, superintendent of the coking plant of the Dominion Iron and Steel Co., has resigned, and goes to an important position with the Maryland St[illegible] Co. [illegible] Sparrow's Point, Maryland. W. S. Hutton, [illegible] of the blast furnaces, leaves for Pueblo, C[illegible], [illegible] a position with the Colorado Fuel and Iron C[illegible]

Charles Brandeis, C.E., Consulting Engineer [illegible], has returned from a two months trip to England a[illegible] many made in connection with some large electric [illegible] and railway plants in Ch[illegible]. Mr. Brandeis while in E[illegible] took occasion to make a careful study of water filtering plants for large cities, and also [illegible] high speed electric railways.

W. C. Wallace, member of the Institute of Naval Architects of Great Britain, has taken offices at 22 Thames St., New York, as American representative of John Brown & Co., Limited, Atlas Steel Works of Sheffield. Mr. Wallace will continue to visit Canada in the general interests of his company whose Canadian agents are Watson Jack & Co., of Montreal.

F. A. Folger, senior manager of the Kingston Light Heat & Power Co., died on the 25th February, of heart failure following a fit of coughing. Mr. Folger had, however, suffered for four years from locomotor ataxia. He was born in Cape Vincent, N.Y., and married Miss Coundale, the daughter of a former city engineer of Kingston, by whom he had four children.

Ludger Trudeau, the new superintendent of the Montreal Street Railway, until a few weeks ago had charge of the Alexandria Tramway System and the Alexandria & Ramleh Railway Company, Limited, Egypt. Mr. Trudeau, who is an old employee of the Montreal Company, after managing the car service of Bordeaux, France, for two years, went to Egypt last June.

RAILWAY NOTES.

The C. P. R. are making large additions to its passenger rolling stock, including sleepers, dining and tourist cars.

The Pennsylvania Steel Co. have a contract from the C.P.R., for 40,000 tons of 80-pound steel rails at $21.75, f.o.b., Montreal, thus breaking the United States steel combine price of $28.

The Ottawa and New York Railway, operating between Ottawa and Tupper Lake, N.Y., is to be converted into an electric road this year. It is proposed to obtain power at Ottawa, Cornwall and Massena Springs, N.Y.

In a speech in the Ontario Legislature on the Temiskaming railway, E. J. B. Pense stated that of the 110 miles of the railway to be completed this year, 90 miles were over a rocky ridge to New Liskeard, but, that the sixty mile extension proposed would be over a level country and connected with colonization wagon roads so that the cost of construction would be one-third less. The estimated cost of $30,000 a mile for the first section included rolling stock at a cost of $5,000 a mile.

P. H. Wilhelm, formerly representing the New York Car Coupler Co., the Washburn Car Coupler Co., the Buckeye Malleable Iron & Coupler Co., the Railroad Supply Co., of Chicago, with headquarters at Atlanta, Ga., has accepted a position as railroad representative of the American Steam Gauge & Valve Mfg. Co., Boston, Mass., with branch offices at New York, Chicago, Philadelphia and Atlanta, Ga. Mr. Wilhelm has spent the greater portion of his life in railway service, and it will be remembered, that in 1893, he was, on the recommendation of the majority of the railways, appointed division superintendent of transportation at the World's Fair in Chicago. After the close of that exposition, he took up the active business of railway supplies, which he has followed up to the present time. Mr. Wilhelm has been very prominently mentioned for the position of superintendent of transportation at the St. Louis Exposition, but he prefers to remain in the active railway supply business. The American Steam Gauge & Valve Mfg. Co. now have the largest plant in the United States devoted to the manufacture of steam and other gauges, safety valves, steam engine indicators, whistles and steam supplies in general, and are the oldest house in America in their particular line.

A line is projected from White Horse to the International boundary, thence via White River Valley to Dawson.

The net profit of the Ottawa Electric Railway last year was $94,542, or nearly 11 per cent. on the average capital stock.

The G.T.P. Railway surveyors have established headquarters for the mountain section at Edmonton, N.W.T. J. R. Stephens is chief engineer.

The Cape Breton Electric Tram Co. propose to extend their system round the Arm from North Sydney to Sydney, and to Little Bras d'Or from Sydney Mines.

It is proposed to build a radial line between Brantford, Ont., and Hamilton, and transmit power to Brantford. Wallace & Little, Woodstock, Ont., are the solicitors.

A line is proposed from Thorold south to Fort Erie, and westerly to Brantford. The project includes operation of steamers and the construction of docks and wharves.

J. S. Clark, of the Grand Valley Railway Co., has located at Galt, Ont., and expects this year to complete extensions north to Galt and Guelph and south to Port Dover.

A railway is to be built from Midway to Vernon, B.C., with a branch to Kelowna. A. E. Ashcroft, engineer, Greenwood, B.C., is interested. The line will be financed in London, England.

The number of persons killed on Canadian railways in the year ending June 30th last, was: Passengers, 53; employees, 186; other persons, 181; total, 420, or 90 more than the previous year. Nine passengers were killed on electric railways.

The Transportation Commission is being urged to extend the I.C.R. from Moncton to Country Harbor, via Pugwash and New Glasgow. The distance is the same as from Moncton to Halifax, but the ocean route would be 100 miles shorter.

It is rumored that Mackenzie & Mann will shortly make the Government a counter proposition to the G.T.P. scheme. The new project comprises the completion of the gaps in their present system, from the Pacific to Edmonton; Port Arthur to Hawkesbury, and Garneau to Moncton.

The Egerton Tramway Co., New Glasgow, N.S., are building a power house, at Stellarton, and track-laying will commence immediately. The directors are R. T. McIllreith, president; Gardner Perry, Boston, treasurer; Charles Warren, and William B. Rogers, Boston and Maynard Reynolds, of Halifax. The Maritime Construction Co. are the contractors.

Canadian charter holders are opposing J. J. Hill's application to the British Columbia Legislature for a line, without bonus, from the Pacific to the Kootenays. It is alleged that Hill's plan is to get access to the Nicola coal and convey it to Everet, which would become the terminus, instead of a Canadian port. The application of the Coast-Yukon Co., of Vancouver, is also being opposed by the Pacific Northern and Omineca Co., which has a charter for a parallel line.

J. J. Nickson & Co., of Vancouver, have a three million dollar contract from the C.P.R. for an irrigation canal twenty miles long, near Calgary. The company propose to build four hundred miles of canal along the Bow river to irrigate great wheat lands adjacent to their railway. The present section is to be forty feet wide, will take two years to construct, and necessitates the excavation of 2,500,000 cubic yards of earth.

The report of the Temiskaming & Northern Ontario Ry. Commission, for 1903, is as follows: Expenditure to date—Location, $50,483.93; construction, $1,888,600.20; exploration north of New Liskeard, $5,841.18; rolling stock, $73,789.56; freight shed, $1,377.55; total, $2,020,092.42. Miles graded, 76. Rails laid, 57 miles. Engineer Russell says the road should be running to New Liskeard by the end of 1904. The cost per mile of the road complete is estimated to be: Grading, trestle work, bridging, etc., $18,000; rails and fittings, ties, ballasting, telegraph line, track-laying, etc., $7,000; terminals, sidings, stations, water-tanks, etc., $1,755; rolling stock, $3,000 per mile. Total, $29,755. It is proposed to extend the road 90 miles to the projected G.T.P. line.

The Terrebonne Electric Railway Co. is applying to the Quebec Legislature for power to erect lines within the counties of Hochelaga, Jacqus Cartier, Laval, Two Mountains, Argenteuil, Wright, Labelle, Terrebonne, Montcalm, and L'Assumption. Also to develop power for traction and lighting purposes.

Application will be made to the Quebec Legislature by the Hon. J. Sharples, Hon. N. Garneau, J. T. Ross, J. B. Forsyth, W. H. Wiggs, Robert Campbell, Dr. A. Lavoie, Armitage Rhodes, A. C. Dobell, Dr. M. H. Brophy, and others, for a charter to construct and operate electric railways between the city of Quebec and points in the county thereof.

The following applications will be made to the Dominion Government: To construct a railway from Ottawa and Hull to Buckingham, thence to the headwaters of the Lievre and James Bay; also from Buckingham to a point on the Ottawa river between Thurso and Templeton; also the right to erect electric power houses, mills and factories. The Ottawa Northern and Western Railway for an extension of time to build from Maniwaki to James Bay; also to build a branch to Lake Temiscamingue and other branches under thirty miles. The Manitoba and Keewatin Railway for an extension of its rights. The Manitoba & Northwestern Ry. to build a branch 100 miles from Sheho southward of Quill lakes, and from Churchbridge to the Pheasant Hills branch of the C.P.R. at Cutarm Creek. For the Walkerton and Lucknow Railway to connect these towns. The Quebec and Lake Huron Railway for an extension of its rights. For a company to connect Crawford Bay with Fort Steele, B.C. For the Edmonton, Athabasca and Mackenzie Railway to build from Edmonton to Peace River, and Great Slave Lake. For the Fort Frances, Manitou and Northern Railway from Fort Frances to the Albany river.

THE GURNEY SCALE CO.

Among the oldest and most successful factories in Canada is the Gurney Scale Co., situated at Hamilton. In 1856, E. W. Ware started the manufacture of scales but it was not until he became associated with the Gurneys, that the scale business began to be what it had a right to be, a prominent feature in the industrial life of that city. In the works today there are many expert scale makers employed and there is not a scale or weighing machine that can possibly be called for in any business that the company cannot make. The business was started right, its promoters determined to make scales that would stand the test, and all down the years of its existence the same determination has been ever before the management, with the result, that the Gurney scales have for years been regarded as standard throughout the whole of Canada. This company now ship scales to foreign countries and such scales are made to indicate the weights used in any part of the world. The latest catalogue of the company shows a great variety of different patterns of scales, and these are made in all standard sizes; but if a purchaser desires a scale to work under special conditions, the company will put its staff of draughtsmen to work out the problem of fitting a suitable scale into difficult or contracted situations. To show the ability of the company to accomplish the unusual, it may be mentioned that a short time since, it constructed and put in position at the Toronto Junction Union Stock Yards the largest stock scale in use in America. This scale will weigh three car loads of stock at one time, having a platform sixty-four by fourteen feet in size, and so true is it and so finely adjusted that the loss from friction according to the public test made when the scale was handed over, was less than five pounds.

While a full line of all sorts of scales is manufactured, the company's specialties are track, wagon and hopper scales, and in these makes the Gurney lines are to be found all over Canada. Here is their motto: "In the past Gurney scales have been characterized by the high standards of design, material and workmanship; in the future yet higher standards will be our aim, and improvements made which successful experience may suggest."

MONTREAL, THE GREAT ELECTRIC POWER CITY.

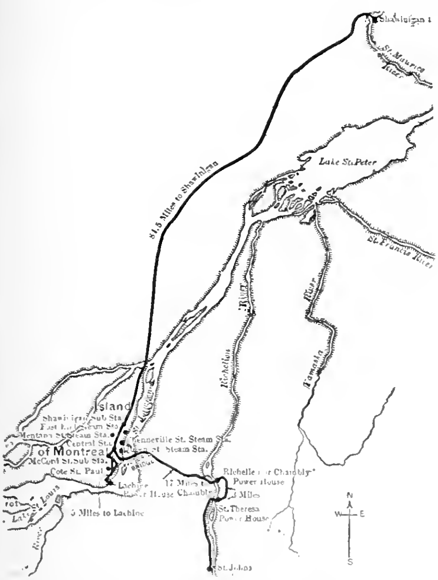
PART 2.

BY ALTON D. ADAMS, IN THE ELECTRICAL WORLD AND ENGINEER.

SUB-STATION WORK.

At the McCord street sub-station the 4,000-volt, three-phase, 63-cycle current from the plant at Lachine Rapids is transformed for distribution to 2,400 volts. This transformation is effected by means of twelve transformers of 250 K.W. each, and four transformers rated at 1,000-K.W. each, their combined capacity being 7,000-K.W. The four transformers of 1,000-K.W. each are connected so as to change the current from three-phase on the primary coils to two-phase on the secondary coils.

At the Shawinigan sub-station, in Maisonneuve, just outside the city limits, the three-phase circuit of three aluminum conductors delivers current at about 44,000 volts and 30 cycles. The generating plant at Shawinigan Falls, on the St. Maurice river, delivers current to the transmission line at approximately 50,000 volts, but the loss in conductors reduces the terminal pressure to about that just stated for the sub-station. Each of the three conductors of the transmission line, after entering the sub-station, is connected to a series of 44 lightning arresters with six air-gaps each, giving 264 air-gaps between each line and ground. Between the connection to lightning arresters and the connection to transformers two static interrupters are connected to each of the three high-tension wires. Each of these interrupters is single-pole, and rated at 50,000 volts, 26 amp., and 2,600 alternations per minute. From the interrupters the 44,000-volt circuit passes to five oil-cooled transformers, which are rated individually at 1,000-K.W., with current at 30 cycles, and at 2,000-K.W. with current at 60 cycles per second. By these transformers the three-phase current is reduced from 44,000 to 2,400 volts, and then passes to five motor-generators that change the frequency from 30 to 63 cycles per second. As at first installed, two of these motor-generators delivered three-phase current at 63 cycles and 2,400 volts, and three of the motor-generators delivered two-phase current of the same frequency and voltage. It is the intention, however, to change two of the motor-generators so that the entire five will generate two-phase current. From these motor-generators the 2,400-volt, 63-cycle current passes to a switchboard in another part of the sub-station, and is thence distributed in part directly to customers of the Montreal Light, Heat and Power Company, and in part by passing through the central sub-station of that company. Under a 50-year contract between the Shawinigan Water and Power Company and the Montreal Light, Heat and Power Company, all of the energy delivered by the former is received by the Montreal electrical supply system, save that a short local railway has the right to use a maximum of 250-h.p. The switch-board installed by the Montreal Light, Heat and Power Company is provided with motor-driven and manual oil switches, that connect the 2,400-volt, 63-cycle bus-bars with the various service feeders. This switch-board is also provided with indicating volt, ampere, and recording wattmeters. The five 1,000-K.W., 30-cycle, oil-cooled transformers, already mentioned, that reduce the transmitted energy from 44,000 to 2,400 volts' pressure, are worthy of note for their large dimensions. The tank of boiler iron, filled with oil, that contains each of these transformers, is cylindrical in form, 15 ft. high, 7½ ft. in diameter, and contains 750 gallons of petroleum. Each of the five motor-generators that receive the current from these transformers is made up of three complete machines, a 2,400-volt, 30-cycle, three-phase, synchronous motor, a 2,400-volt, 63-cycle, two or three-phase alternator, and a 125-volt, direct-current exciter of 583-amp. capacity. These three machines are direct-connected and operate at the common speed of 450 r.p.m. The motor and alternator are both of the type with internal revolving magnets, and stationary armature coils. A solid coupling unites the shafts of the motor and alternator and the extended shaft of the latter carries the armature of the exciter. The exciter magnet frame is mounted on a solid extension of the alternator base. To secure alignment of the motor and alternator in each unit their bases are bolted to four 15-in. I-beams that are embedded in the concrete foundation. Each I-beam is 25 ft. long. The extreme width of each motor and alternator base is 11 ft. 2 in. From the bottom of the I-beams to the top of the motor frame the distance is 9 ft. 5¼ in. Over the three machines that make up each motor-generator unit the extreme length parallel to the shaft is 29 ft. 5 5-16 in. Each direct-current exciter furnishes current to the magnet coils of both the motor and alternator to which it is mechanically connected. In the sub-station with the five motor-generators just considered there is a smaller motor-generator made up of a 100-h.p., 30-cycle, three-phase, 2,300-volt motor, direct-connected to an 85-K.W. 125-volt generator. Current for this 100-h.p. motor is taken directly from the secondary side of the static transformers. When one of the large motor-generators is to be started, each of which is rated at 800-K.W., the 85-K.W. generator is driven by the 100-h.p. motor, taking current from the secondaries of the static transformers, and the 125-volt direct current thus obtained is used to operate the exciter of the large motor-generator as a motor. As soon as the large motor-generator reaches its synchronous speed its motor is connected to the transformers that deliver energy from Shawinigan Falls, and the 85-K.W. dynamo is disconnected.



Map Showing Location of Water Power Plants and Distributing Stations.

The Shawinigan sub-station is of brick 95 by 115 feet, one story high, with a roof supported on steel trusses, and a concrete floor. Internally the main building comprises two rooms in one of which the five 1,000-K.W. transformers are located, and in the other the motor-generators. A wing at one side of the main building contains the switchboard equipments through which energy is delivered to the lines of the electrical supply system.

THE CENTRAL SUB-STATION.

The central sub-station, located in the block bounded by Ottawa, Wellington, Prince and Queen streets, is the largest and most important connected with the Montreal system. To this sub-station come the high-tension transmission lines from the water power at Lachine Rapids, Chambly, while the Shawinigan system is also connected through the 2,300-volt feeders that come from the Shawinigan sub-station. Energy at 2,000 volts, 63 cycles two-phase from the McCord street station, and at 22,000 volts, 63 cycles, three-phase from Chambly, is transformed at the central sub-station to current at 2,300 volts, 63 cycles, two-phase, for general distribution. Ultimately, the equipment of main transformers at the central sub-station will comprise sixteen

units of 2,750 K.W. each, and of these units ten are already installed, giving a present capacity of 27,500-K.W. These transformers are of the air blast type, and were made by the Westinghouse Electric Manufacturing Company. Besides these main transformers receiving energy direct from the transmission lines, the central sub-station contains thirty transformers of 60-K.W. capacity each, for the operation of enclosed, alternating arc lamps in series for street lighting. Each of these transformers with its regulator delivers a constant, alternating current of 7.5 amp. and a maximum pressure of 4,000 volts. These constant-current transformers which take energy from the main transformers at 2,400 volts and deliver it at any desired voltage up to 4,000, were made by the Western Electric Company.

Current for the 250 and 500-volt, three-wire system, which operates direct-current motors, is supplied by two motor generators at the central sub-station. Each of these motor generators is made up of a 300-K.W., 2,400-volt, two-phase synchronous motor, and a 250-K.W., 250-volt, direct-current generator. These two synchronous motors draw their energy from the main transformers. To maintain the pressure in the air chamber beneath the air-blast transformers, space has been provided on the main floor of the sub-station for four blower units, and three of these units are in position. Each blower unit is made up of one 40-h.p., 550-volt, two-phase induction motor, of Westinghouse make, with a centrifugal blower with a 32-inch circular opening on each end of its shaft. These blowers were made by the Sturtevant Company, and are intended to maintain a pressure of 1.8 inches of water per square inch.

Provision is also made on the main floor for two motor-driven exciters to furnish direct-current to the magnets of the large machines, and also for an emergency set consisting of a 300-K.W., 2,400-volt, two-phase synchronous motor direct-connected to an alternator of equal capacity. All of the transforming and converting apparatus just named occupies a central position on the main floor of the sub-station, save the constant-current transformers. Ranged about three sides of the sub-station in galleries and on one side at the main floor level are the high and low-tension switchboards that receive, control and distribute the energy from the water power plants. In the gallery on one of these three sides are the marble and soapstone compartments that contain the knife switches for the high-tension lines from the water-power plants. From these switches the 22,000-volt, three-phase circuits pass to the primary coils of the main transformers. The secondary, 2,400-volt circuits from these same transformers go to the transformer panels and distributing board in the gallery on another side of the sub-station, by the way of manually operated oil switches located in the same gallery. The gallery on a third side contains another portion of the distributing switchboard. Beneath the gallery on one side of the sub-station are the thirty constant-current transformers, already mentioned, on the main floor. An arc lamp switchboard, connecting these transformers with the series circuits for street lighting, separates the space beneath the gallery last named from the central portion of the main floor, where the large transformers, motors, and motor-generators are located. This arc switchboard is the only one on the main floor level. The fourth side or front of the sub-station, where the large, main entrance is located, is free from electrical apparatus, and starting from this side a travelling crane sweeps the entire central space of the main floor. This crane is driven by electric motors, and has a capacity of 30,000 pounds. It was built by the Niles Company.

The building of the central sub-station is one of the largest and best to be found anywhere for this purpose. Because of the high voltage and great amount of energy entering this sub-station, and its importance in the Montreal electrical supply system, it was located in about the centre of a city block, so that a large, clear space was left between each of its outside walls and the public street. The building is one story high above basement, nearly square in outline, of pleasing architecture, and as nearly fireproof from foundation to roof as steel and masonry can make it. Inside the dimensions are 118 feet by 122.5 feet, and from the main floor to the lower cord of the steel roof trusses is 34.5 feet. The lowest part of the roof outside is 41 feet above the main floor. Beneath the entire main floor there is a basement paved with concrete 1 ft. thick. The surface of this concrete is 7 ft. 10½ in. below the main floor around the outer portion and 11 ft. below in the central portion of the building. In this central portion of the basement a space 37 feet 8 inches by 65 feet 2 inches is enclosed for an air pressure chamber by masonry walls each 2 feet thick. On the main floor over this air chamber are set the sixteen 2,750-K.W. transformers and the four blower units. The floor space actually occupied by the group of transformers with an aggregate capacity of 44,000-K.W. is within 38 by 40 ft., and it may be doubted whether an equal capacity of transformers can be found within so small a space elsewhere. Beneath each transformer and each blower an opening in the main floor permits the movement of air out of or into the chamber. The air forced into the chamber by the blowers rises through the transformers and may escape through the windows in the side walls, or the skylight.

In its central portion the main floor of the sub-station was designed to support a superimposed load of 400 pounds per square foot, and along the sides beneath the galleries the design was for 70 pounds per square foot. Seventy pounds per square foot was the specification for the strength of all gallery floors. For the roof a safe capacity of 125 pounds per square foot was required. Structurally the sub-station is composed almost entirely of brick, tile, steel and stone. The stone foundation extends from 9 ft. 8 in. below to 5 ft. 3 in. above the ground line, and its footing 7.5 ft. wide rests on natural soil. Above this stone foundation the walls are of brick with heavy stone belt courses, plinth course, pier blocks, lintel, moulded course, pilasters and coping. At intervals along their outsides, and at the corners the brick walls are reinforced by heavy piers. Between these piers the regular thickness of the brick wall is 21 in.

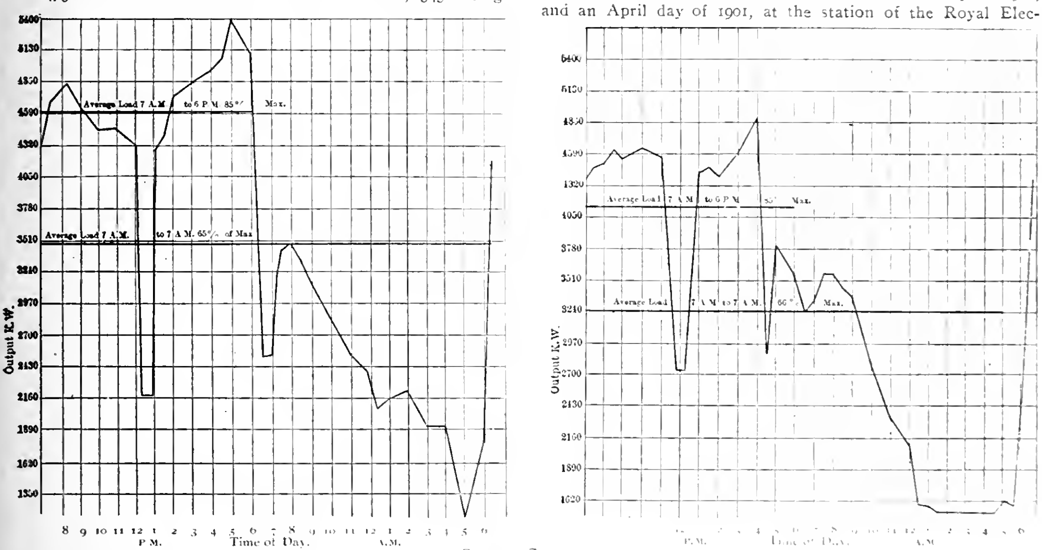
All stone and brickwork in the building, save that with pressed brick, was laid with a mortar composed of one part Portland cement and two parts sharp sand. Spaced along the brick walls of the sub-station with their footings in the stone foundation, and also along two sides of its central floor space, are a number of steel columns that support the I-beams for the main floor and the gallery floors, the traveling crane and also the steel roof trusses. The brick walls thus carry only their own weight. Under the central part of the main floor there are independent foundations that carry the heavy machinery there located. As a part of the steel columns is built into the brick walls, the stability of the latter as to any side strains is thereby greatly increased, the steel work being tied together from one side of the station to the other. Steel I-beams carried by the vertical columns and the central foundation walls and piers support the main floor of the sub-station. The first or lower gallery floors are also laid on I-beams secured to the vertical columns. In the second or upper gallery the floor is laid on heavy angle steel shapes that are carried with their supports by the columns in the brick walls. The framework of stairways leading from the basement to main floor, from the main floor to the first gallery, and so on up to the second gallery, and the roof is of iron and steel, and the treads are of slate. A framework for the sides and roof of the skylight is built up of angle steel and I-beams resting on the steel trusses carry the main roof.

The main floor, that of the first gallery and the roof, are all built up of terra cotta arches. On the second gallery the floor is laid with slate slabs. On the main and first gallery floors the tile arches are covered with a granolithic mixture of cement, sand and crushed granite 2½ in. thick. Over the terra cotta blocks and I-beams of the roof a coating of cement mortar at least ½ in. thick was laid to an even surface. On this surface there was placed a layer of boiling pitch, and then tarred felt roofing with another outside coating of the pitch. After this last was dry, boiling asphalt was spread over the roof to a depth of ¾ in., and in this hot asphalt book tiles 1 in. were laid with ¼-in. joints. The ceiling of the roof was plastered with a mortar composed of one part cement and two of sand, and then with cement and plaster of paris.

ECONOMIC ASPECTS.

The showing of 46 per cent. of the gross earnings as net income in the Montreal system, as above noted, has been made through good engineering. This will be appreciated from the fact that the regular rate for electric lighting in Montreal is 15 cents per K.W.-hour, while the rates to very large consumers like the cotton mills and the street railway compare favorably with the cost of steam power. Without neglecting the various other elements that affect the operative efficiency of a great system like that at Montreal, a special effort has there been made to reduce losses in distribution and build up a relatively large day load of motors. As has already been pointed out, the Royal Electric Company was the largest distributor of electrical energy in Montreal prior to the formation of the Montreal Light, Heat and Power Company, of which the former company is now one of the constituent units. In 1896, P. G. Gossler, until recently general superintendent and engineer of the Montreal Company, presented a paper at the annual convention of the Canadian Electrical Association, giving some interesting facts as to the methods followed to reduce distribution losses in the system of this latter company, among which the results of changes in the number and type of service transformers may be noted. The object in these changes was to displace smaller transformers by a less number of larger ones, and to supply consumers as far as practicable from secondary mains having approximately the lamp voltage. Following out this idea, reconstruction was begun on the alternating lighting service of the Royal Company, which included 1,160 transformers wired up to about 53,000 incandescent lamps. In the course of this construction 473 of the old transformers were removed, 345 being replaced by new transformers, eighteen taken down because the service was discontinued, and 110 disconnected because the customers served by them were connected to other old transformers nearby. Meantime 229 new transformers were connected to the lines, and of these 187 replaced old transformers and 42 were used for new customers. These changes left 916 transformers wired up to 60,000 lamps. With the 1,160 transformers and 53,000 lamps on the lines during the year preceding this construction, the smallest load at the station was 380 amp. During ten months after the reconstruction the minimum load on the station with 916 transformers and 60,000 lamps connected to the lines was 245 amp., or 135 amp. less than that with the previous smaller number of lamps and larger number of transformers. This saving of 135 amp. in the minimum load was obviously due to less leakage of current through the new transformers than through the smaller ones that were removed. For the 229 new transformers the leakage current was 19 amp., from which it follows that the leakage of the 473 old transformers that were removed amounted to 135 + 19 = 154 amp. Of the total saving of 135 amp. in leakage current, 36 amp. was due to the removal of the 110 transformers whose lamps were connected to other old transformers through secondary distribution mains. From this it appears that by replacing 345 of the old by 187 new transformers a saving of 99 amp. in leakage current was effected. The entire cost of making the changes in the 187 transformers and the distribution lines, including the cost of the new transformers, amounted to $65 per transformer on an average after the value of the old transformers, as scrap, was deducted. It was computed that the saving in the cost of coal at $2.75 per ton amounted to $25.58 annually for each of the 187 transformers on an average, so that the reduction in the outlay for fuel alone would pay for the change in about 2½ years. It was also computed that when the 1,160 old transformers have all been replaced by 636 new transformers, the leakage current would be reduced to less than 75 amp. As the Montreal plant was operated twenty-four hours per day, it was further estimated that the reduction of 135 amp. in the leakage current resulted in a yearly saving of $7,348 for coal at $2.75 per ton. Looking at the 135 amp. as capacity for an increase of load, it was said to correspond with 2,700 lamps of 16-c.p. in operation, or about 9,000 such lamps connected to the system.

Perhaps the most notable result in the operation of the distribution system at Montreal, as it stands to-day, is the great increase in the connected load of stationary motors, and the relation of this motor load to the maximum load at the station. These results are brought out clearly by the records of kilowatt outputs during a December day of 1900, and an April day of 1901, at the station of the Royal Electric Company. During the twenty-four hours of the December day the average load at this station was 66 per cent. of the maximum load, and during the twenty-four hours of the April day the average load was 65 per cent. of the maximum there. These exceptionally high average loads show at once the influence of the relatively great capacity of connected motors, but the mystery is how a day load of motors, however great, can bring the average so far up toward the maximum load. As is well known, a day load of motors operating from 7 a.m. to 6 p.m. laps well over on to the heavy lighting load during the late hours of each afternoon during the winter months, and thus presents a direct addition to the maximum station load. With the great motor load at Montreal it has been necessary to avoid the conjunction of the normal motor and the maximum lighting demands. That this result has been reached at Montreal may be gathered from the fact that the average load at the station of the Royal Electric Company from



Output Curves.

7 a.m. to 6 p.m. was not only 85 per cent. of the maximum load during the April day, but was also 85% of the maximum of the December day, when the annual maximum of the lighting load would naturally be reached. The fact that the regular motor and the maximum lighting loads do not coincide on the Montreal system is made still more evident by the location of the maximum station loads as to time of day in winter and spring. On the April day, above mentioned, the maximum station load occurred at 5 p.m., and on the December day this maximum came just prior to 4 p.m. Light must be had when wanted in Montreal, as elsewhere, and the maximum station load in December was kept down by cutting off a large part of the motor capacity before the great bulk of the lamps were turned on.

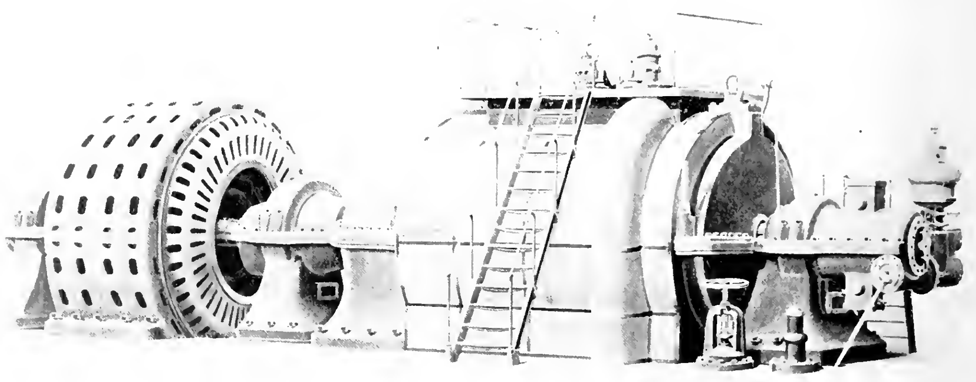
This disconnection of a large part of the motor load at 4 p.m. during the winter months is provided for in the contracts with some of the heaviest power users at Montreal, and the merit of the plan is shown by its success. If large consumers of power are able to purchase it at a very attractive figure prior to 4 p.m. on each day, there seems to be no good reason why they should not do so even though the supply is not available after that hour. The success of power sales on this basis seems to be in the nature of a personal triumph for Mr. Gossler, who has advocated it for several years. (To be continued.)

HIGH POWER WESTINGHOUSE-PARSONS STEAM TURBINES.

The 5,000-K.W. turbo-generating unit, illustrated herewith, is representative of the general type of steam turbines which will be constructed for large powers. The principle of operation, as well as the general relation and arrangement of rotating and stationary elements, characteristic of former types, has been employed in its construction. The largest machines therefore find their direct prototypes in the original design adopted, thus in a measure vindicating the wisdom of adherence to the design of maximum simplicity, viz., the horizontal single-cylinder turbine. The most distinguishing features of the new type are the extreme compactness and low speed secured. The space occupied by the 7,500-h.p. turbine is approximately 27 ft. 8 in. by 13 ft. 3 in., and the height to the top of the hand-railing is 12 ft. This is equivalent to .049 sq. ft. (less than one-twentieth sq. ft.) per electric horse-power capacity, or 20.2-h.p. per sq. ft. of floor area required. For the complete unit a rectangular area of 47 ft. 4 in. in length and 13 ft. in width is required, equivalent to .084 sq. ft. per E.H.P. capacity, or 2 E.H.P. per sq. ft. of floor space.

The economy of space is well illustrated by the fact that four 5,000-K.W. Westinghouse-Parsons turbo-generators require a slightly less floor space, than two 5,000-K.W. compound engines and generators at present installed in the Manhattan Railway power house, New York.

In point of speed, the new type fulfills the demand for a unit operating at moderate speed. The 5,000-K.W. units operate at 750-R.P.M., the 2,000-K.W. unit 1,200-1,560-R.P.M., and the 1,000-K.W. unit 1,500-1,800 R.P.M., depending upon the frequency desired. These speeds, although not comparable to engine speeds, do not impose much greater stresses upon the rotating parts, and in addition secure the great advantage of reduction in the bulk, weight and cost of the unit. The unit rests upon a single bed-plate cast in two sections, which are secured by shrunk links. To the bedplate, which is heavily ribbed to secure rigidity, are bolted the pedestals, generator casing and turbine body, but the bedplate itself is not secured to the foundation by other means than the weight of the unit. Steam and exhaust connections are made beneath the floor level. In the smaller machines of this type, the cylinder barrel and both journals are cast in a single casting, thus largely minimizing machine work. In the large machine, however, the barrel is cast in two sections united by links, the outboard section carrying the journal and worm casing, and the inboard section the journal and exhaust opening which extends through the bedplate. As in former types. linear expansion and contraction of the turbine are provided for by a sliding foot. The inboard journal pedestal is bolted securely to the bedplate, but the outboard pedestal is free to slide between parallel machined ways. The main body of the casing is heavily lagged with non-conducting material, secured in place by sheet steel casings. Leakage of air from the atmosphere into the exhaust spaces of the casing at the entrances of the shaft is prevented by frictionless packing glands. No oil is employed and in consequence the condensation from the turbines is pure distilled water. In shaft construction great rigidity has been secured with a minimum use of metal. A central steel quill carries the entire rotating parts, both blades and balance pistons. Hollow forged steel ends are forced into the two ends of this quill, under hydraulic pressure, and are in addition secured by arrowhead links. High pressure steam is conveyed to all parts of this quill structure in such a manner as to eliminate stresses and consequent distortion due to highly superheated steam.



Power is transmitted to the generator shaft through a flexible coupling which is housed partly by the turbine and partly by the generator inboard journal. The coupling is split at the junction of the two shafts, so that by removing one bearing cap and the coupling bolts either section of the unit may be lifted out without disturbing the adjustment of the remaining section. In the smaller sizes the engagement surfaces of the coupling consist of the squared or hexagonal

ends of the shafts, but in the larger machines a crow foot sleeve is keyed to each shaft and the power is transmitted by an outside quill engaging the crow's feet. Thus great flexibility is secured, together with the greatest facility in dismantling. The journals in the larger machines are of the solid self-aligning type, similar to that employed in generators and cross-compound engines. The departure from the familiar oil-cushioned journal employed in the small machines is occasioned by the speed reduction secured. The journal shells are babbitt lined and are split horizontally, the two halves being united by bolts with shim adjustment. Oil from a central system is introduced at the centre under slight pressure, thoroughly flushing all parts. Axial adjustment is provided by metal shims arranged in quarter-box fashion. The diameter of the shaft at the journal of a 5,000-K.W. machine is 15-in., strikingly small in comparison to the 34-in. shafts required for a cross-compound reciprocating engine of corresponding capacity. Longitudinal adjustment, to reserve proper side clearance, is secured by a thrust bearing located next to the outboard bearing. The bearing is not subjected to longitudinal thrusts from the action of the steam and is consequently of small size. The two half shells are advanced in opposite directions by graduated set screws, so that the actual running clearances are measured in thousandths of an inch. Once set, these adjustments are permanent and do not require frequent "taking up."

Steam enters the turbines successively through an automatic quick closing throttle, hand throttle, strainer and the main admission valve. A circular steam port, surrounding the entrance to the initial stage conveys this steam to all points so as to avoid stresses incident to more localized admission of highly superheated steam. An important feature of the steam distribution system is the provision of a by-pass valve. This valve admits high pressure steam to the second stage of the turbine on overloads in order to increase its capacity, up to 50 per cent. in excess of full rated load. By properly proportionating the by-pass steam to the overload on the turbine, maximum economy may at all times be secured, together with reserve overload capacity. This results in a slight rise in the economy curve on heavy overloads, resembling in some respects the engine economy on loads exceeding that of maximum economy. The turbine, however only suffers in economy at heavy overloads while the engine economy decreases progressively from 75 to 80 per cent. of full load capacity. The main admission valve consists of a double beat poppet valve operated by a small piston, this in turn being controlled by a small pilot valve directly actuated by the governor mechanism. The valve admits steam to the turbine in puffs, the duration of which are proportioned by the governor to the load upon the turbine. This intermittent method obviates the throttling of steam to accommodate loading and secures the highest economy by using at all loads steam at boiler pressure. At the extreme outer end of the turbine shaft is mounted a worm-driving horizontal cross shaft. This shaft drives at one end the oil pump and at the other end the governor through bevel gearing. An eccentric provides the reciprocating motion necessary for the valve mechanism.

The governor is of the fly-ball type, with 90 degree bell crank ball levers mounted on knife edges and fitted with roller contacts. The governor sleeve and spring is mounted on ball bearings, and adjustment of the spring tension may be made while the turbine is running, thus affording a most simple and convenient means for paralleling alternating current generators and dividing the load proportionately between them. At the extreme end of the outboard pedestal is mounted an auxiliary speed limit governor. It is likewise of the centrifugal type, and may be set to release, at any predetermined speed, a small plunger valve which controls with high pressure steam the operation of the quick closing throttle before mentioned. This is normally held open by means of an overbalanced differential piston. At the moment the speed limit operates, the excess pressure is removed and the throttle closes. This device is employed for insuring absolute immunity from accident from excess speeds, due to the possible disablement of the governor mechanism. Copious lubrication is supplied to all journals by means of a plunger pump driven from the worm shaft. The warm oil returning from the bearings passes through a copper coil cooler in the bedplate and thence to a reservoir from which the pump draws its supply. The cooled lubricant is circulated at slight pressure, sufficient to ensure positive flow. At no point is oil under high pressure employed for preventing erosion of rubbing parts, bearing areas being sufficient for supporting the weight of the rotating parts.

In general construction the 5,000-K.W. turbo-generators conform to those now building for smaller machines. The field or revolving element is built from a solid cylinder of steel slotted for the reception of the bar windings, and provided with ventilating openings corresponding with openings in the laminations of the stationary element. The generators may be wound for high voltage, if desired, in order to avoid the use of step-up transformers in a system of power transmission at voltages ranging up to 15,000. The type here illustrated will form the initial equipment of the Pennsylvania Railroad Terminal property in New York City, operating with electric locomotives the heaviest Pullman trains through the tunnel approaches to Manhattan. Three units will similarly inaugurate the power service on the Philadelphia Rapid Transit Subway System now under construction. Eight 5,000-K.W. units will furnish power to the London Subway System, and three 3,500-K.W. units to the surface system of the same city. These units will operate under 175 lbs. steam pressure, high vacuum and 100 to 175 degrees of superheat.

PUBLIC PATENTS.

Editor, Canadian Engineer:—

Sir,—Inventors frequently fail to put their ideas before the public owing to poverty, doubt of financial success, and other causes. A patent costs $50, besides search and model; and it needs $20,000 to ensure successful manufacture and sale. I once showed a self-inflating connection to fill a belt, buoy, or boat, to the late Steamboat Inspector, who stated that if I had the sum named to float advertisement and sale, it would be a fortune; but without that amount it would be a certain loss to the holder of the patent. A similar, if not identical, contrivance was successfully exhibited on the Serpentine, London, but it is not yet in general use. If facilities were offered inventors for placing their patents on record for national benefit, with security against any fraudulent imitation by private firms, more useful inventions would become public to the general advantage. It might be free to any person who took out a license to manufacture and sell, but without any monopoly, as in present patents. If its merits proved obvious and important, the Patent Office might pay the inventor say 5 per cent. on the average sales as a public acknowledgment of his service to the nation. Sales to foreign countries or individuals would be made by the Commissioner for the national treasury, so that each public patent would be a national asset.

I further suggest that a list of public and private patents be published monthly with notes on the more important—much in the style of the Scientific American—but as public information, like our cold storage and agricultural bulletins, for public benefit only. I claim that such a plan would stimulate invention, aid poor inventors, and distribute the accompanying benefits more widely than our present system. I cannot suggest a more suitable journal to place these inventions before the people than the Canadian Engineer. Much of the information it furnishes is for the benefit of the great public, as well as for engineers only, and public aid in illustrating and advertising new ideas offered freely to all the community would be as fairly earned as any other Government advertisements. The essence of civilization is the extension of co-operation in subsistence, defence, transports, education, and, in short, all the necessaries and comforts of life. The more a society co-operates in all the relations of citizenship, the greater the aggregate value of its labor, because there is no loss by competition duplicating the same labor; and no drones feeding from the civic honeycomb. A logical corollary from public

patents would be the national manufacture of utilities by national water-power or electricity derived therefrom. As these goods would be manufactured with every advantage of cheap patents and power absolutely at first cost, they could be sold at a uniformly cheap rate, and as the public needs required, without even being slaughtered below cost. A uniform quality, price, and demand, would, indeed, form an ideal condition in commercial life. As the province of Ontario has very properly assumed possession of the minerals discovered while grading the Temiscaming Railway, another vista is opened of a national mining, smelting, and metallic manufacture, entirely regulated by the Government under such conditions that the nation could be supplied without either trusts and syndicates to raise prices artificially, or slaughter below cost when suffering from redundant production.

A third vista is opened by assuming the lumbering operations on the public lands by Government mills, foresters, and transportation. By cutting only ripe trees, carefully carbonizing the waste material, and never overstocking the market beyond actual requirements, our lumber, minerals, water-power and transport can be made quite as stable as taxes, interest, or real estate. It would also enable a Government to regulate labor and wages; by employing only competent, reliable men, and paying such wages as would fairly remunerate them, we would secure the best men for the national service; and the careless, ignorant, intemperate, or unsettled, would be compelled to seek private employment, often at lower wages. By nationalizing all railways, vessels, and other means of transport, we could at length organize, discipline, and efficiently control all the forces of national activity, and use the whole force of strength, intelligence, organization, and administrative ability for its comfort and progress in peace, and its defence in war—either military or commercial. This is my ideal of a civilized nation.

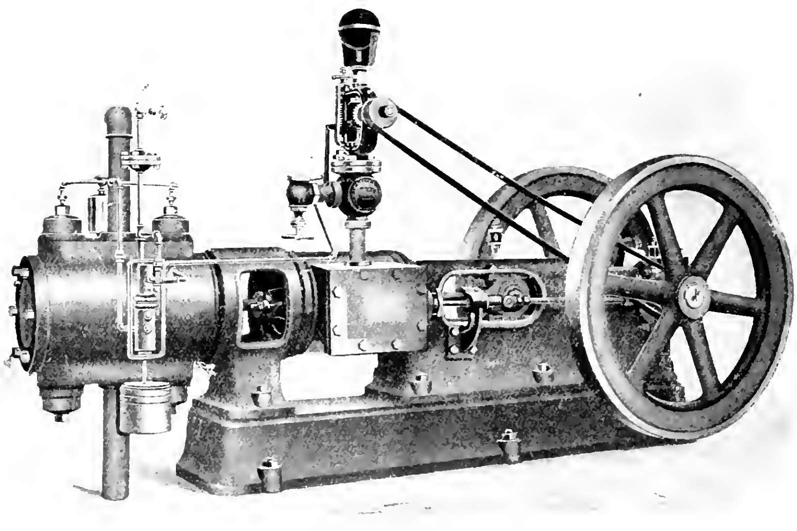
THOS. FROOD.

FRANKLIN AIR COMPRESSOR.

The new type of air compressor, here shown, is made by the Chicago Pneumatic Tool Company, Fisher Building, Chicago, and 95 Liberty street, New York, at their Air Compressor Works, Franklin, Pa., and is designed to meet the growing demand for an efficient, simple and compact compressor furnished at a moderate price. This form of compressor is made in a variety of sizes and styles, starting with a minimum capacity of 30 cubic feet of free air per minute, single, duplex, or compound, actuated by steam, belted, chain driven, or geared to an electric motor.

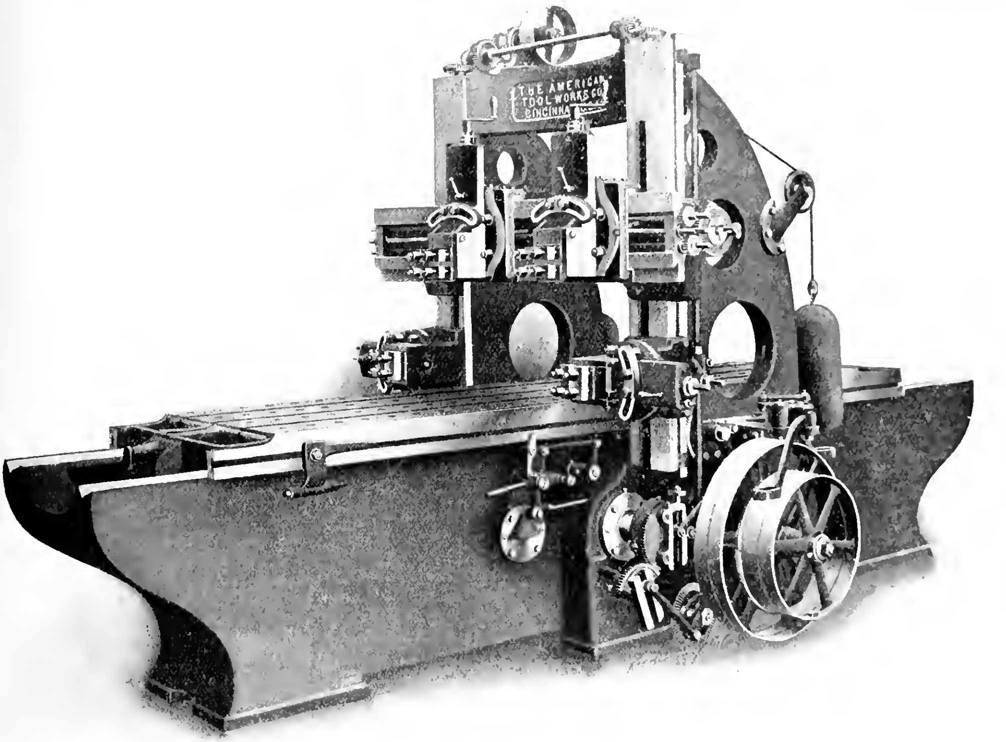
It is described by the makers as follows: The frame is of box section design, with large factor of safety to withstand all strains when working at maximum load. It has bored cross-head guide, and provision for catching and removing drip from bearings and stuffing boxes. Compressors having cylinders 8-in. in diameter and larger are furnished with or without sub-base. When furnished with base the compressor is entirely self-contained, obviating the necessity of expert services in erecting, and reducing cost of foundation. Air cylinder and heads are completely water jacketed, with thorough circulation of water, affording equal cooling at all points. Steam valves on cylinders under 12 inches diameter are of plain slide type accurately scraped to seat and securely fastened to rod. Cylinders 12 inches diameter and larger are provided with Meyer Adjustable Cut-Off Valves and Gear. Air valves are of poppet type, made from high grade steel, having removable seats and guides, easily renewed or repaired and thoroughly guarded from entering cylinder in case of breakage. They are placed radially in cylinder, making them readily accessible, ensuring accurate seating, and reducing wear to a minimum. The pistons are of solid type with cast iron spring rings accurately fitted. Piston rods are of best machinery steel. Shaft is of centre crank type with exceptionally heavy crank arms, made of best open hearth steel of ample diameter, accurately finished. Cross-head is of cast iron with adjustable shoes to top and bottom. Connecting rod is of best open hearth steel, with bronze cross-head pin boxes having wedge adjustment. Crank pin end is of marine type lined with genuine babbitt metal. Compressor is furnished with two wheels, one on each side of compressor, turned true, and keyed to shaft, of sufficient weight to ensure smooth operation. An unloading device is provided to relieve the compressor of all load when the desired air pressure is obtained, and automatically cause it to resume delivery when the storage pressure becomes reduced. Cylinders have provision for indicator connections. A pressure regulating governor is provided, to automatically control the operation of the compressor in accordance with the demand for air, working in connection with a speed governor for regulating the speed of the engine.

These compressors are submitted to a working test before shipment, and although designed primarily to supply compressed air power for operating pneumatic tools in railway shops, machine shops, foundries, shipyards, and stone yards, they are suitable for actuating rock drills, coal cutters and other machinery in mines, tunnels, and quarries, pumping water by the air lift system and for every other purpose to which compressed air is applied.



NEW THIRTY-SIX INCH PLANER.

The accompanying illustration presents the new standard metal planer just brought through by the American Tool Works Co. of Cincinnati. The machine contains a number of original features, radical departures from former patterns, in order to meet successfully the greatly increased strains imposed upon planers by modern methods in shop practice. The bed is exceptionally deep, extending almost to the floor line, with short, substantial legs, cast with the bed. Heavy box cross girts at short distances give the bed a great rigidity. Bed is very long in proportion to table length, leaving but little overhang to table when planing at full length. The central portion, where the strain is heaviest, is strongly reinforced. The table is of ample proportions, well braced by ribs to obtain great strength without unnecessary weight, is equipped with improved dirt-proof feature, and has quick return, reversing without shock or jar. An improved form of shifting mechanism removes the belt from one pulley before the return movement belt engages the other, thus obviating all disagreeable shrieking of belts. A safety locking device prevents the table from starting before the operator is ready. Heads are firmly secured to saddles on cross rail by four bolts instead of two, as on most planers. Feeds are automatic in all directions, and can be operated from either side of the machine. Side heads can be furnished, as in the illustration, at any time after the machine is built, with slight modifications. Slides are so constructed as to permit of planing at some distance from the housing. Rail heads and side heads have separate feed mechanism, which operate entirely independently in all directions, and at either end of the stroke. The action of this planer is said to be remarkably smooth. In planing work, which is afterwards to be scraped to a surface, the evenness of the cut is such as to reduce the necessary scraping to a minimum.



* * *

Additional plant is being installed at the Cumberland mines, Vancouver Island, and the output of anthracite coal will shortly be 300 to 400 tons daily. It is reported that J. J. Hill's Pacific liners will take the whole supply.

THE METRIC SYSTEM.

Editor, Canadian Engineer

Sir,—Referring to the letter of the [illegible] E. Johnson, which appeared in your issue for February, I note the statement that: "It is not a fact that in France and Germany there are used old units side by side with those of the Metric System. There do exist old names—or nicknames—for some of the present units," etc.

That statement could only have been made by some one who is in entire ignorance of the facts.

I have in my possession a scale, "made in Germany," on which there are graduations for the Rhenish and the French inches, which are in large use in their respective countries. Mr. Johnson may find an engraving of this scale on page 40 of The Metric Fallacy. Will he be so good as to say for which metric units the Rhenish and the French inches are nicknames?

In Zeitschrift des Vereines deutscher Ingenieure for September 5th, 1903, he may find a table (reproduced on page 42 of The Metric Fallacy), of a standard of pipe and pipe threads, which was adopted at the annual meeting of the German Society of Engineers last July, and in this table he will find the bore of the pipe and the pitch of the threads given in English inches and in no other way. Will Mr. Johnson please tell me for what metric unit the term English inch is the nickname?

In Leipziger Monatschrift for October 31st, 1902, he will find a German yarn table (reproduced on page 180 of The Metric Fallacy), in which, against the set of the loom in threads per Vienna inch, he will find the weight in English pounds of the yarn required for 100 meters of cloth. Will he tell me for what metric units the Vienna inch and the English pound are nicknames?

In L'Industrie Textile for October 15th, 1902, may be found an article by a leading French textile authority, M. Paul Lamoitier, reading in part as follows:

"It is absolutely unworthy of us French, who were the first to find and apply the Metric System, to retain the aune and denier for measuring silk. Ah! these Americans are not

considerate of our feelings and they are right. We are as much in the anarchy of weights and measures for the textile industry as at the time of the Revolution, for we have the denier of Montpelier and of Milan, for silk, with the aune as a unit of length. We still have the diverse standards of Roubaix, Fourmies and Reims for worsted, the moque of Sedan, the livre, the quart and the sous of Elboeuf, the yard for linen, etc. Ah! the famous aune, do you know its equivalent? Exactly 3 feet 7 inches 10 lines and 10 points, or in other words, 1.188447 metres, the foot being equal to .324839 metres and divided into 12 inches, the inch into 12 lines and the line into 12 points.

"The yarn count in the north of France is a length and in the centre, a weight. I will take my oath that the manufacturer of Rouen, if he has not studied each section separately, has no idea what is the standard of Reims or the denier of Lyons or Milan. And on the other hand, the manufacturers of Reims and Lyons are likewise puzzled in making comparisons of the diverse numberings of the diverse materials.

"And this is the reason why they are right in mocking us when they say we do not use the Metric System for numbering yarn and for weaving calculations. Nothing is more arbitrary than to reckon the yarn by the thousand metres and the width of the cloth and the picks of the filling by the inch. It is nonsense and a derision. Note also that, while I speak here only of France, I could say as much of all Europe."

You will note the value of the aune, given with so much care by M. Lamoitier, but Mr. Johnson would have us believe that the word aune is only a nickname for metre! Let him not overlook the last sentence by M. Lamoitier, and let him also note that the value given for the foot stamps it and the inch, line and point as French units, and will he then tell us for what metric units the French foot, inch, line, and point, stand as nicknames?

In Kalkulator für Artikel der Textil branche, by Friedrich Frowein, page 79, may be found a table (reproduced on page 181 of The Metric Fallacy), giving the value of eight of the old ells, which are still in use in German textile mills. The values are given in centimeters, as 67, 62, 78, etc., but Mr. Johnson would have us believe that the word ell is only another nickname for aune.

Since the exposure by my associate, Mr. Dale, and myself of the persistence of old units in metric countries, the explanation given by Mr. Johnson has appeared many times, but, in unfeeling Yankee slang, it is "too thin," it "won't wash." In hastily adopting this explanation of uncomfortable facts, the metric advocates are only continuing the convenient process of assuming anything to be true which they would like to have true, as described in the following extract from the preface of The Metric Fallacy:

"Whenever the metric advocates have learned that a government has passed a law favorable to the system, they have straightway conveniently assumed that it has become the common system in trade and commerce. They have not enquired into the working of these laws nor into their scope or nature. Their logic has been: 'Such a country has passed a Metric System law, therefore the people of the country have dropped their old units and taken up the new.' Their stories of the imposing number of hundreds of millions of people who use the system have no other basis than this. They have simply added the figures for the population of those countries which have passed some kind of a metric law, including those in which the laws are simply permissive, and those in which the system has been adopted for government purposes alone. If the facts which are given in these pages turn their case to ridicule, they have nothing to thank but their own credulous willingness to believe anything favorable to their system and to their free use of their own imagination without regard to facts."

Mr. Johnson should try again; really, though, Mr. Editor, doesn't it strike you as a little odd to see the English system assailed from England and defended from the United States? I do not need to remind you that Mr. Johnson is not at liberty to ignore or evade my questions. The large use of these old names is proven, and, having made this ridiculous explanation, he will now show for what metric units they are used as nicknames, or your readers will understand that he has abandoned his explanation.

I probably know about as much about the present state of the Metric System bill before the American Congress as Mr. Johnson does, and I am ready to stake my reputation as a prophet on the prediction that it has no better chance of becoming law than Mr. Johnson has of being struck by lightning.

New York, February 22nd. F. A. Halsey.

❧ ❧ ❧

A. M. Chrisholm, of Kingston, Ont., has received an enquiry from Germany as to the cost of iron pyrites, feldspar and graphite. If prices are satisfactory a large trade may be worked up between Canada and Germany in these minerals. All three minerals are found in Frontenac County and graphite is plentiful in Lanark County.

❧ ❧ ❧

IMPERIAL DEFENCE.

Editor, Canadian Engineer:—

Sir,—Our present inter-ocean railway, (the C.P.R.), was mainly intended by its promoters to divert American traffic to the shorter Canadian route; it is located too near the boundary to be of any military dependence in case of our needing strategic arrangements in our continental relations. It could be rendered useless at many points in the Eastern part; it is exposed from Heron Bay to Port Arthur, and from Winnipeg to the Rockies is within reach of a cavalry raid from the south. This is a fatal objecton to the scheme of R. L. Borden for the purchase of the most expensive and least productive portion round Lake Superior, and leave the present monopoly to take full toll at both ends of the division under our control. The Grand Trunk Pacific (if well fortified at its western terminus), presents an ideal military route —only to be reached after an arduous campaign, and only to be held by an army able to cover a long line of supply.

By the Ottawa Ship Canal, the Great Lakes could be filled by gun-boats and cruisers within a few days, and present the best possible frontier defence for Canada. I consider this canal, the completion of the Rideau Canal, to meet enlarged requirements, and the first duty of our Government to provide.

The third and most essential would be the extension of our militia law, as to provide for the military training in our Public and High Schools of all our youth in squad and company movements, skirmishing, scouting, the construction of firearms, and some target practice with air-rifles of 1 per cent. power. Every school section should have its company of adults, and every township its battalion. Every factory, foundry or other industry (bonused by the tariff), should have its own corps, with special adaptation to its daily employment and usefulness. Each railway should enroll all its employees as minute men to guard and repair its lines in case of assault; they would know better than others what to guard, where to fight to advantage, and how to repair damages.

The older Grand Trunk lines would form the skirmish line; the C.P.R. the first main line of defence, and the Grand Trunk Pacific would be the central route and second line of defence. Troops could move with celerity and safety from the battlements of Quebec to the batteries of Port Simpson, and by cross lines send aid to the frontier at any threatened point.

The fourth and last line would be Hudson's Bay and the roads from it to the G.T.R. from Moose Factory, Churchill, and possibly Chesterfield Inlet, and the Mackenzie and Yukon basins.

Canada's lumbermen, miners, and pioneers would form a corps of nearly a quarter-million, who, in our back country could set all the world at defiance while supplies and ammunition lasted. The American Revolutionary War showed what pioneers can do against European troops; the war of 1812-14 proved that the invader is at an immense disadvantage; and the defender, who knows the ground, is able to perform miracles of defence and surprise. The chief merit I claim for

this scheme is that it requires no masses of men to be abstracted from useful employments and maintained by the workers. The only outlay would be for arms and fortifications. The latter could be largely erected by the men as a portion of their drill, and the railways by adding a few armored trains could largely increase their efficiency and the safety of their men.

Canada could thus be made a factor second only to the navy in the globe-encircling line of Imperial defence.

THOS. FROOD.

PUMPING BY ELECTRICITY.*

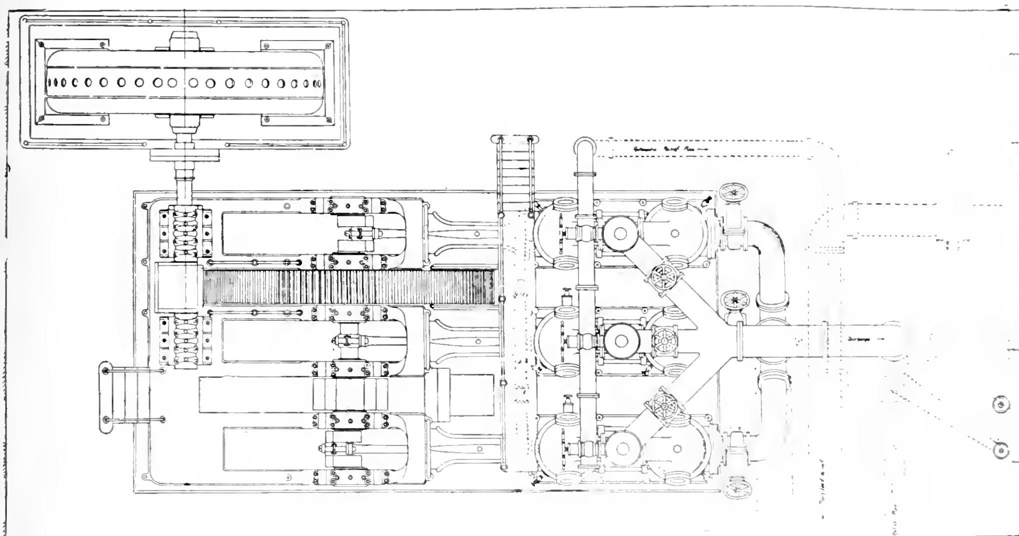
(Continued from February issue.)

THE CLARKE AVE. ELECTRIC PUMP.

The chief considerations here in connection with an electric plant were, after durability and efficiency, the avoidance of undue noise and vibration. Accordingly a pump was designed and installed in August, 1901, much like the first one, but heavier and better built. Many mechanical changes were made, most of which were found to be improvements. Types of rotary pumps then on the market were considered but discarded.

the general arrangement of gearing was the same as the first. The motor being built for a slighter slower speed, viz., [illegible] revolutions per minute, allowed for the same [illegible] with a correspondingly smaller reduction ratio. The gearing consisted of two mortise wheels carried by the [illegible] crank shaft, 140 maple teeth, 200.52 inches (16 feet [illegible] inches) pitch diameter, 18 inch face, 4.5 inch circular pitch (these teeth were hand dressed); and two machine-cut steel pinions carried by the same jack shaft, [illegible] inch pitch diameter, 18 teeth. Reduction ratio, 7.88. The steel forged three-throw crank shaft is 11¼ inches diameter through crank pins and journals and 13½ diameter at gear hubs, overall length 16 feet 11 inches. Distance between gears is 6 feet 3 inches. Arrangement of bearings, etc., is as with the other pump. The jack shaft is connected with motor through a 500-h.p. 48-inch Worrall clutch. This clutch consists merely of a cast-iron disc keyed to one shaft which is gripped between shrouds keyed to the other. The usual lever and toggle joint link is employed to operate it. The disc and shrouds are bevelled, which ensures accurate centering. On the whole this clutch has been found satisfactory.

The permanent induction motor for this pump, which was contracted for in 1901, was, at the time, the largest of the type ever built. There is only one other as large, and that



Montreal Water and Power Co., Triplex Power Pump, Clarke Ave. Station.

is a duplicate built for the electric pump of the City of Montreal now being erected. This machine, being a special one of very slow speed, was naturally late in coming. A temporary drive was therefore arranged so that the pump could be started in the summer of 1901. This consisted of a 200-h.p., three-phase, 600 revolutions per minute alternator, belt geared to a 10-foot pulley on a temporary jack shaft, erected on timbers from the permanent motor foundation. The regular clutch was used at this time and proved a very necessary part of the equipment. This arrangement had a pinion shaft speed of 100 revolutions per minute, which brought the load within the capacity of this temporary motor. This drive ran eight months, from August 1st, 1901.

When this pump was first started it seemed satisfactory. The gearing made only a slight rumble and there was very little vibration. It seemed as if the ideal in electric power pumps had been reached. Soon, however, it was noticed that the wooden cogs were fraying, and the action of the gears consequently became less smooth. In less than six weeks it was necesary to recog these gears. This was done by taking one out and running the pump in the meantime with the other pair. After the first one came back, and while the other was away to be recogged, it was noticed that the gears ran better and lasted longer with one pair than with two. On investigating it was found that at the periphery of these 17-foot wheels there was a spring between them of over one-

The capacity of this pump was fixed to begin with at 4,500,000 Imperial gallons. This gives easily an additional 1,750,000 over the old steam plant at this station. The new pump is, however, designed to run up to 7,000,000 Imperial gallons by merely changing the pinion. This is ample to provide for normal increase at this point for some years.

In event of a low-level reservoir being established at the proper level for the supply of the greater part of the territory, a heavier pump than the first would be necessary. At the same time, such a large one would then not be required at Clarke Ave. Accordingly, this pump was designed all around for a working pressure of 175 pounds, with a view to removing it to the river for the proposed new service. Its present head is about 118 pounds. This brought its weight (exclusive of motor), up to nearly 375,000 pounds, the lower pump being about 275,000 pounds. The chief differences between this pump and the other are, first, the gearing, which consisted of mortise gears and steel pinions; steel babbited boxes instead of phosphor bronze; marine crank ends; pillow blocks adjustable on frames; steel plunger rods instead of bronze and the carrying of these rods through the cylindrical plunger and securing by a taper in front and a locked nut at the back were other differences.

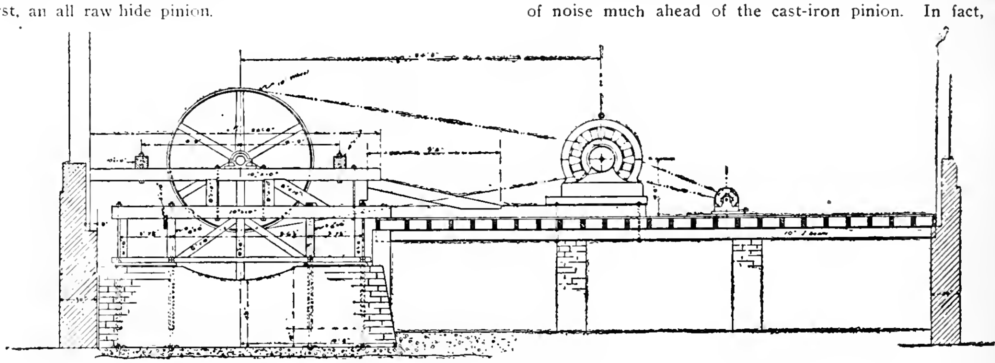
This pump is a 10½-in. by 24-in. horizontal triplex, and

*From a paper read before the New England Waterworks Association, by F. H. Pitcher, chief engineer of the Montreal Water & Power Co.

quarter inch, when a tangential force equal to 150-h.p. at 100 revolutions per minute of the jack shaft was applied. This was, of course, due to spring in the crank shaft. When the stresses on the gears are considered in relation to the resultant of the three-crank effort curves, it is at once apparent that there is, during every revolution, a fluctuating load between these gears. This is brought about by the outside cranks, whose load is, from the nature of things, not shared equally at all times by each gear as with the centre crank. Taking this, together with the unavoidable spring in the crank shaft, it was apparent that there would always be a certain amount of hammering or pounding between these wooden wheels and their respective pinions. The writer was then satisfied that with this arrangement such large mortise wheels could not be made to work. The builders, however, claimed the trouble to be due to the unsteady support of the pulley end of the pinion shaft, which, being supported on timbers built up on a foundation about 7 feet below, was not of course the most rigid holding. Considerable oscillatory motion of this end of the jack shaft occurred. By turning the wooden wheels around, and running with one pair, the pump was kept in operation until the permanent motor arrived. When this was installed it was at once clear, even to the builders, that the gearing arrangement would not work, and it was forthwith abandoned in favor of that now running. This consists of a single pair of gears—the face being widened to 24 inches—a machine cut cast-iron wheel, and, at first, an all raw hide pinion.

through from end to end. While this pinion ran it was extremely noiseless at times, but atmospheric changes, particularly the amount of moisture in the air, seemed to have considerable effect upon it. An appreciable variation in the running of gearing was observable, apparently from no other cause than atmospheric changes. A cast-iron pinion was cut as soon as possible and installed in place of the raw hide one, pending the arrival of the pinion now running. The first raw hide pinion was, of course, the largest ever attempted in face and mass of raw hide. But in the writer's opinon the very quality to which raw hide owes its noiselessness—viz., the spring—renders an all raw hide tooth of such a length impossible for heavy work. The teeth, as mentioned, spring away from the work in the middle, or point of maximum bending moment, and, the cast-iron teeth of the gear being relatively rigid, too much work comes on the ends, which in consequence show excessive wear in a few days. Unfortunately the writer was unable to hold a post-mortem on this pinion, without which the above is offered as an explanation of its failure.

The pinion now running is one-third brass; that is, it is cut from a blank having a section of brass in the middle 8 inches wide, with 8 inches of raw hide on each side. The whole is keyed as well as bolted to the cast-iron centres, which makes a rigid point in the middle of the face of the teeth. This pinion has run since April 9th last, and shows only a slight amount of wear. It is not, however, in point of noise much ahead of the cast-iron pinion. In fact, with



Montreal Water and Power Co., Temporary Drive, Clarke Ave. Station.

It having been observed that the gears ran better when the working pair was in the pit next the motor, it was thought that a jack shaft of large diameter would tend to smoothen operation. Furthermore, with a two bearing support for the pinion shaft as would obtain, it was decided to abandon the spherical bearings and substitute stiff bearings of a greater length. Accordingly, a 10-inch pinion shaft with bearings of 3.9 diameters (approximately) was installed. The particulars of this pair of gears are as follows: One machine-cut spur cast-iron gear 24-inch face, 179 involute teeth, 3½-inch circular pitch, pitch diameter 199.42 inches, or 16.61 feet.

The all raw hide pinion has a 26-inch face, 24 teeth, 26.7 inch pitch diameter (approximately). Reduction ration, 7.45.

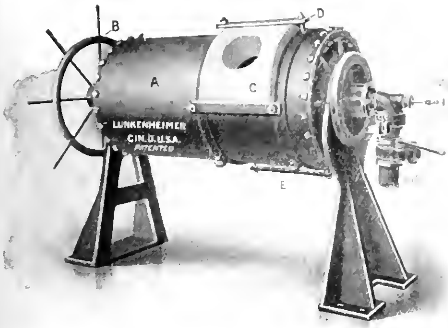
This pinion ran for six weeks, and then failed much as the others at the lower station did, but from another cause. The shrinkage was much less, the raw hide undoubtedly being a superior article, but something happened inside the pinion which prevented it being taken up. It is the writer's opinion that the raw hide contracted radially and got between the ends of the cast-iron centres carried by the shrouds. However, in spite of plenty of clearance at the ends of the pinion, it was found impossible to compress the hide in the middle so that it was sufficiently tight. The consequence was the load all came on the ends and the teeth got out of shape, causing extreme heating in the pinion. The co-efficient of expansion of this substance being high, the ten 1⅞-inch steel bolts holding the raw hide laterally were broken as quickly as they could be renewed. The raw hide itself stood the test, and did not break as with the other. The raw hide was not keyed to the cast-iron centre or otherwise secured, except by the bolts passing

its present slight wear it is doubtful whether it runs as smoothly as the iron pinion. The raw hide people are anxious to try again, using an all raw hide face having the raw hide keyed to the centres. I understand they now have one of that type under way. This pump runs only 20 hours a day, and there is therefore ample opportunity to take up the slack in the raw hide, etc.

LUNKENHEIMER METAL FURNACE.

The Lunkenheimer Metal Melting Furnace for melting brasses, bronzes, etc., has been evolved after considerable experimenting with nearly every type of furnace on the market. As will be seen from the cut, the furnace consists of a cylindrical sheet-steel drum A, having cast-iron heads. The interior of the drum is lined with fire-proof tile, and there are two openings on opposite sides of the drum. Only one of these openings is in use, the other being closed by a fire clay filling. The object of having two openings is to increase the life of the linings of the furnace. It has been found that the furnace wears out quicker around the filling hole (which also serves as outlet for the flame) than elsewhere. The advantage claimed for the Lunkenheimer furnace is that when one filling hole is worn out, it can be closed by a fire-clay filling and plate, the furnace reversed, and the other hole cut out and put in service. The oil burner is of a special type, designed to give the greatest amount of heat with a minimum consumption of oil. In the Lunkenheimer foundry there are ten of these furnaces in use, and they are able to secure from six to seven heats per working day of ten hours from each furnace. The weight of each heat will average

about five hundred and fifty pounds, and the oil consumption varies from two to two and one-half gallons of crude oil per hundred pounds of metal melted. The life of the linings is from three to four hundred heats, this varying with the kind of metal melted. It is easy to re-line, which cannot be said of all types of furnaces. With the first furnace



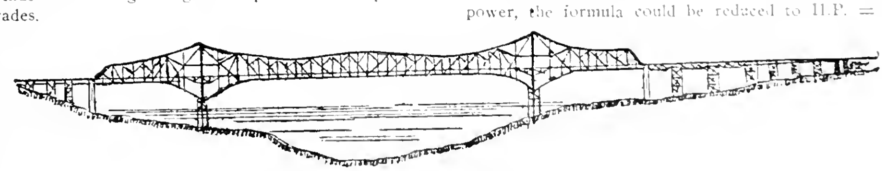
sold to each customer within a radius of one thousand miles of Cincinnati, the makers send an expert to start the furnace and instruct the furnace-room employees as to how to secure best results in handling, etc.

Further particulars can be had from the manufacturers, the Lunkenheimer Co., Cincinnati, O.

PROPOSED BRIDGE OVER STRAIT OF CANSO.

Waddell & Hedrick, Kansas City, Mo., have been instructed by the Strait of Canso Bridge Co. to prepare full working plans for the proposed cantilever bridge across the Canso Strait. It is estimated to cost $5,000,000, and will have the largest span in the world, viz., 1,800 feet, being 100 feet more than the longest span of the Forth Bridge, and 205 feet more than that of the Brooklyn Bridge. The total length of the bridge from shore to shore will be 3,300 feet, and the main span will be 150 feet above high water level. 35,000 tons of steel will be required for its construction, all of which could be supplied from the mills which the Dominion Iron and Steel Co. propose to establish at Sydney, C.B., this year. The work will take about three years to complete.

The approach on the Cape Breton side will be made by a branch line from the I.C.R., near Point Tupper, to the Hastings end of the bridge. The connection from Cape Porcupine will be by a spur line to the I.C.R., near Harbor au Bauche Station, thus overcoming the greater part of the present heavy grades.



Strait of Canso Bridge.

This bridge will save about one hour on every trip to and from Cape Breton at no greater cost than that of the present service. The completion of this bridge will enable the I.C.R. to run night trains to and from Cape Breton, and it is believed that it will increase the chances of Sydney harbor being made a port of call for the Canadian fast line.

Mr. Waddell, the head of the firm of Waddell & Hedrick, is a Canadian by birth, and is considered one of the best authorities on bridge structure on this continent. His text books: "De Pontibus," and others, for bridge engineers, are universally used by the engineering fraternity in the United States and Canada. He was professor of engineering in the University of Japan for some years, and was knighted by the Emperor for his services in that capacity.

THE ASSOCIATION OF ONTARIO LAND SURVEYORS.

The twelfth [illegible] meeting of the [illegible] Ontario Land Surveyors [illegible] held in Toronto [illegible] 24th, and 25th, under the presidency of W. R. [illegible]. Those present included: Capt. K. Gamble, Major [illegible], G. B. Kirkpatrick, H. de Q. [illegible], T. H. [illegible], [illegible] Brown, J. F. Whitson, W. A. McLean, A. J. Van Nostrand, D. D. James, A. T. Ward, T. B. Speight, and G. W. McFarlen, of Toronto; W. R. Aylsworth, Belleville; [illegible] A. Niven, Haliburton; A. S. Code, Allenston; E. T. Wilkie, Carleton Place; C. A. Jones, London; W. M. [illegible], Strathroy; L. V. Rorke, Sudbury; G. L. Brown, [illegible]; James Robertson, Glencoe; J. W. Fitzgerald, Peterboro; J. H. Shaw, North Bay; G. A. McCubbin, St. Thomas; T. [illegible] Fawcett, Niagara Falls; P. S. Gibson, Willowdale; J. W. Tyrrell, and E. G. Barrow, Hamilton; J. Patten, Little Current; W. J. Blair, Berlin; and J. A. Calvert, St. Joseph, Mich. The president in his address referred to the satisfactory condition of the association, and stated that efforts were being made to improve the present high standard of the profession. The secretary-treasurer, Capt. Killaly Gamble, reported that the association's finances were in a satisfactory condition.

At the afternoon session, a paper by E. C. Steele was read on "Surveys of Mining Claims," in which the writer referred to the surveying of claims staked out by licensees under the Mines Act in the unsurveyed territory of Ontario, and dealt with the difficulties encountered by surveyors in defining the correct boundary lines from the unprofessional methods generally adopted by the licensees. All lines should be run on an astronomical north, south, east or west course, but licensees as a rule possessed neither the instruments nor knowledge to enable this to be done and the surveyor's mission was to evolve mathematical accuracy out of chaos. The paper contained many suggestions as to how this could best be accomplished.

A paper on "Water Power Surveys and Reports," by W. A. McLean, was listened to with much interest. The writer stated that the estimated developed water powers of the principal countries of the world were: Germany and Austria, 180,000-h.p.; Switzerland, 160,000-h.p.; Sweden, 200,000-h.p.; United States, 400,000-h.p. The available water-power was: Sweden, 2,000,000; France, 10,000,000; Germany, Austria, Switzerland and Italy, 10,000,000-h.p. Niagara Falls could furnish 6,000,000-h.p., half of which belonged to Ontario. Reference was made to the Government regulations regarding water-powers, and suggestions were made as to the best methods of ascertaining the volume of water, height, and power of a fall. With regard to the latter, the following formula was suggested: $HP = .00189\,VH$, in which H is the height of the fall, and V the cubic feet of water, per minute, passing over it. As turbines could utilize 75 per cent. of the total horse-power, in determining the effective horse-power, the formula could be reduced to $HP = .0014\,VH$. The permanency of the fall and opportunity for storage were matters to be carefully considered in estimating the value of water powers. The cost of power depended upon the capital necessary for development, and in that respect must rest upon individual merits and the ingenuity of the engineer. The placing of dams, head-race, penstocks, flumes, tail-race, buildings and plant were dependent on natural surroundings and demanded originality in making the best use of them.

Other papers read were "The Board of Examiners," by Charles Unwin, and "The Amateur Assistant on Survey Parties," by J. Collins.

On February 24th the report of the Committee on Drainage was presented, after which P. S. Gibson read a paper on "A Few Points Relating to the Ditches and Water Courses

Act," in which he dwelt with disputes arising out of drainage, how to avoid and dispose of them. He recommended that councils should have the right to put in culverts on roads, if necessary, to get rid of water, without recourse to the cumbersome proceedings under the Ditches and Water Courses Act. A paper of exceptional value to surveyors in New Ontario, north of the "Height of Land," was read by James Robertson on "Equipment and Supplies." Many pointers were given to surveyors in that country, also as to the nature and quantity of victuals required, and the best mode of transporting and storing them. The outfit should average 100 pounds per man, exclusive of food supplies, and including instruments, tools, cooking utensils, tents, blankets, etc. Each package should not exceed 100 pounds, so as to admit of convenient handling. The paper concluded with a detailed list, stating number of articles, quantities and supplies taken by the writer on a 68 days' trip with twelve men in 1902. After the reading of this paper, a general discussion followed in which the members unanimously agreed that the present rate of nine cents per acre was totally inadequate for surveys in the district referred to, several of the speakers stating that instead of receiving any personal remuneration, the net result of their last season's work had been a deficit. G. B. Kirkpatrick, director of surveys, promised to lend his aid in endeavoring to arrive at a more satisfactory method of payment for these surveys in future, and a resolution was passed in support of the petitions of individual members asking the Crown Lands Commissioners to grant some compensation in those cases where losses have already been incurred.

"Transportation" was the subject of a paper by J. S. Sing, in which the writer referred to the large sums spent by Canada and the United States on the Soo canals and locks, amounting to $15,000,000. The tonnage of freight passing through the locks had increased from 181,938, in 1865, to 1,321,200 in 1885, and from 15,062,146 in 1895, to 35,961,146 in 1902. Of the total traffic, five-sixths passed eastward to the Atlantic, and one-sixth westward, the total value of this commerce being $358,306,000. The net tonnage of vessels passing through the Suez Canal was less than one-third of that of the Soo. 25,000,000 bushels of Canadian grain were exported from Canadian ports in 1902, and 22,000,000 bushels of Canadian grain were shipped via United States ports. Canadian grain last year supplied 21 per cent. of New York grain exports, 40 per cent. of Boston, and 65 per cent. of Philadelphia. Duluth had grown at the expense of Chicago. Duluth's wheat receipts in 1901 were 18,000,000 bushels; Chicago's, 41,000,000; while in 1902 the figures were, Duluth, 43,000,000; Chicago, 38,000,000. In 1903, 19,000,000 bushels of grain were carried by boat from Lake Superior ports to Kingston some of which cost only three cents a bushel for transportation, while from the same ports, via Georgian Bay, and thence by rail to Montreal, the cost was from three and three-quarters to four cents. The large lake freighters had carried grain from Duluth to Georgian Bay ports at three-quarters of a cent per bushel. The grain carried by the Grand Trunk and Canada Atlantic during 1903 was: From Depot Harbor, 15,000,000 bushels; Midland, 14,000,000; Collingwood, 1,200,000; and Meaford, 5,000,000, a gain of 5,000,000 bushels over 1902. 45,000,000 bushels of grain were shipped through Canadian ports in 1902, compared with 184,000,000 via Buffalo. These figures pointed to the necessity of Canada making strenuous efforts to divert a share of this trade through Canadian ports. There were two ways of doing this; one by doubling the capacity of the Georgian Bay elevators, and reducing the grade and easing the curves of the railways to Montreal; the other way was to increase the capacity of the canals to accommodate the largest boats, on which another $100,000,000 must be spent if the canal system was to be an important factor in transportation. The Manitoba wheat production had increased in five years from 7,000,000 to 23,000,000 bushels, and at the present rate of increase, by 1913 the crop would be 242,000,000 bushels, exclusive of the yield farther west. These conclusions pointed to the possibility of there being four or five transcontinental lines during the present generation.

In the discussion which followed, J. Alex. Culverwell called attention to the additional transportation facilities which would be gained by the completion of the Trent Valley Canal. This could be done for five million dollars, making the total cost of the waterway nine millions, as compared with $100,000,000 to be spent on the Erie Canal. Out of the 200 miles from Midland to Lake Ontario, only 18 miles were actual canal. Freight could be handled more economically by the barge system in canals than by the large lake carriers. Germany had adopted barge canals for carrying ore to the shipping ports, as also had the United States from Buffalo to New York, therefore, the Trent Valley waterway should not be neglected, but should be completed without delay, and the public should be induced to realize the importance of this work in its relation to grain transportation.

J. F. Whitson read a biographical paper on the work of David Thompson, astronomer royal, 1784-1850, the first white man to navigate the Columbia river from its source to the Pacific, and who made many journeys across the North American continent. Thompson prepared many valuable maps as the result of twenty-eight years' surveying, but the importance of his work was not appreciated by the Government, and he died in poverty. Mr. Whitson thought it no wonder that boundaries were disputed when the work of early explorers and surveyors had received so little encouragement. T. Wilkie followed with some notes on the original survey of Hawkesbury Township, 105 years ago, and the reports of the council and board of examiners were presented by G. B. Kirkpatrick.

On February 25th, the report of the Committee on Engineering was brought in by E. G. Barrow. He also presented a paper on "Cement Concrete Sidewalks in Hamilton," which he strongly recommended, in the face of the increasing cost of wood and the necessity for a permanent material. In Hamilton, 96 miles of this walk has been laid in five years at a cost of 12.5 cents per sq. foot. Curbing cost 33 to 40 cents per lineal foot. The paper included some suggestions as to the position, the grade and the fall which sidewalks should have. The reports on exploration and polar research were taken as read, and A. R. Davis presented a useful paper on reciprocity between land surveyors' associations as to examinations.

In the afternoon, the Legislative Committee's report was presented by Major Sankey, a discussion following. It was stated that loose methods were observed in the filing of plans by certain railways. Under Dominion charters, engineers had the privilege of signing the plans. Under provincial charters, the plans have to be signed by surveyors. All plans should be signed by provincial surveyors, as some were submitted to the Railway Committee, which did not represent true surveys, and it was not in the public interest that such practices should continue. Some legislation was needed to prevent men leaving the employ of surveyors without reason or notice, the surveyor being out of pocket, and the public service suffering thereby. Major Sankey suggested that the Commissioner of Crown Lands be approached on the subject. He did not want a one-sided agreement, but there should be some penalty for men who desert surveying parties without reason. The report was adopted.

A resolution of regret on the death of John McAree was carried, and the retiring president was accorded a vote of thanks.

C. A. Jones, Petrolea, was elected president; J. W. Tyrrell, Hamilton, vice-president; Captain Killaly Gamble, secretary-treasurer; J. F. Whitson, and W. A. McLean, auditors. Two members of the council are to be elected by letter ballot, the nominations being P. S. Gibson, E. T. Wilkie, Thomas Fawcett, M. Gaviller, C. C. Fairchild, L. V. Rorke and James Robertson. The other members of the council are: Hon. E. J. Davis, Alex. Niven, A. J. Van Nostrand, G. B. Kirkpatrick, and Villiers Sankey.

The annual dinner was held at McConkey's on the 24th, W. R. Aylsworth presiding. Speeches were made by the Hon. E. J. Davis, Commissioner of Crown Lands; Col. Otter, E. D. Armour, Prof. Galbraith, Principal Manley, and others. There was a good attendance.

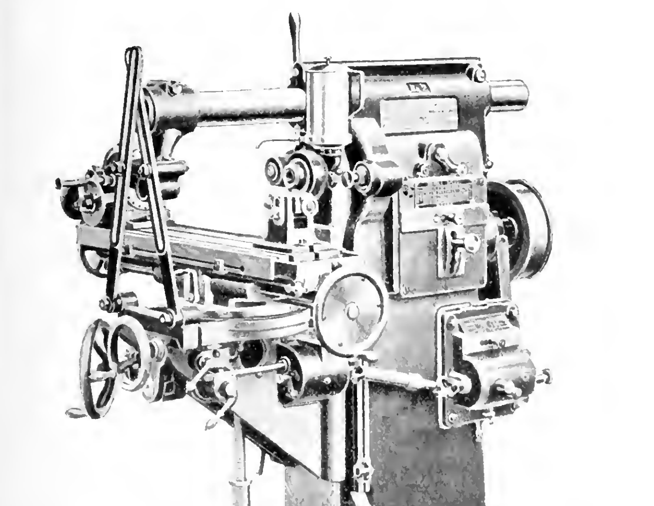
The following are the results of the annual examination before the Board of Ontario Land Surveyors: Final—J. W. Fitzgerald, Peterboro; W. J. Blair, Berlin, J. H. Smith,

Pembroke; Messrs. Fitzgerald and Blair have been sworn in. Mr. Smith will be sworn in on the expiry of his article of apprenticeship. Preliminary examination for apprenticeship —T. G. Code, Alvinston; E. P. Bowman, West Montrose; W. Raywood Smith, London; W. H. Holland, Toronto.

MOTOR DRIVEN MILLING MACHINES.

The difficulties that have arisen in the application of the motor drive to machine tools not designed with this in view are probably familiar to our readers, who will be interested in the constant belt speed milling machine, described herewith, as being adapted to the application of this drive, and they will also be interested in the other mechanical features of this machine.

As to the motor drive, it will be readily apparent that, with a constant drive for the machine itself, the simplest constant speed type of motor of any standard make can be applied and the full efficiency be at all times available. The milling machine is one recently placed upon the market by the Brown & Sharpe Mfg. Co. It presents many features that show a radical departure from the well known milling machine construction. The difficulties inherent in the usual cone drive and a table feed dependent upon the variable spindle drive are entirely eliminated. The main drive is direct from the countershaft to the machine pulley by a belt that runs at a constant speed and provides for the use of the same size pulley on both the machine and counter-shaft, thus giving a much greater belt contact and driving leverage than can be obtained with the usual cone drive. All spindle speed changes are provided for in the machine, the changes being obtained by means of gearing. Spindle gearing has a ratio varying from zero to 20 to 1.



Referring to the illustration, directly to the left of the main driving pulley will be seen a plate with two adjusting levers and an index slide between them. The index slide determines the combination of gearing between the driving pulley and spindle. The lower lever carries the intermediate and engages the gears after they have been set; the upper lever gives two series of speeds, one fast and one slow, which, together with the back gears, give 16 changes of spindle speed varying from 15 to 370 revolutions per minute in either direction. The back gears are operated by a lever in the usual way; the locking pins that engage the spindle sleeve, replacing the cone head, are operated automatically by the movement of the lever controlling the back gears.

The table feeding mechanism is an important feature. The mechanism is new in design, and gives a wide range of feeds that fully covers all requirements of modern milling practice. The gearing is all spur gears with properly proportioned bearings, thus reducing the loss of power by friction and insuring an unusually high efficiency. The feed changes are obtained by the simple movement of a lever and index slide. The drive is from the machine pulley shaft by chain and sprocket wheels, and as this shaft runs at a constant speed, it is possible to obtain a table feed that is independent of the spindle speed, thus giving a fixed rate of correct feeds in inches per minute, in relation to the spindle speeds, for all diameters of cutters. The range of feed obtainable with this mechanism varies from ½-in. to 6-in. per minute, which gives for small mills a range from .001-in. to .016-in. and for large mills .033-in. to .400-in. per revolution of spindle. Another feature of importance is that the table feeds and spindle speeds are in geometrical progression, which is recognized by the leading engineers as the most satisfactory for this class of machine tools.

THAWING WATER PIPES BY ELECTRICITY.

Unusual trouble from the freezing of water mains and service pipes has been reported from many cities and towns, both in Canada and the United States, and the Canadian Engineer has had enquiries from both sides of the line as to a method of thawing pipes by electricity briefly described in our issue of February, 1903. As the Ottawa Electric Co. has frequently come to the relief of the Capital City, which has suffered much during the past winter from the severe frost we give below details of the method employed there, as kindly furnished by A. A. Dion, general superintendent, in reply to our enquiries:

"Regarding the thawing of pipes by electricity, I think we were the first in Canada to do it, though I believe it had been done at one place in the United States before, that was four years ago. This year the cold has been so severe that the city has not been able to cope with the trouble of frozen pipes with the ordinary means at hand, such as steam boilers mounted on sleighs, etc. If the freezing has extended into the street they can do little and that only at a great expense. The City Engineer having asked for our assistance, we rigged one of the company's express sleighs for the purpose. Four transformers of 5,000 watts each were put in this sleigh and connected two in series on their primary side. The secondary connections were such that when the transformers were attached to the line wires by means of small flexible rubber covered cable, each transformer got half the primary voltage for which it was made, and the secondary voltage was about 25 volts. The normal current capacity of the secondaries as connected was 400 amperes. We also had a rheostat in series with the primary cables and an ammeter. A board about 6 ft. long was set upright in the sleigh, on this a shelf was attached for the ammeter and a cross piece at the top

carried two primary cutouts, to which were attached the cables to line wires. Two coils of No. 0000 insulated cable, each about 200 ft. long, were carried for secondary connections. One connection from the secondary of the transformers was made to the lead pipe inside the building where water was stopped. This connection was made by means of a brass clamp which surrounded the lead pipe without injuring it, and afforded sufficient surface to pass a large current to the lead pipe without burning it. The other secondary lead was taken to the next house or to the nearest hydrant. Care was taken to connect to the lead pipe below the point where the pipe was empty because the empty pipe would heat too much with some currents which were used. The currents varied from about 90 amperes to about 275, and the time occupied before water would flow varied from four minutes to three hours. Usually if there is any chance of success, results will be seen in a very few minutes. In some cases we could not get enough current through to produce any satisfactory results. This was attributed to bad joints in the pipes causing unusual resistance. Three men went with the outfit, one driver and two linemen."

We have just received the following interesting report from Harry A. Lord, superintendent of waterworks, Ogdensburg, N.Y., where 4,000 feet of water and gas pipes were reported to be frozen between the 15th and 20th of Feb. Ogdensburg was one of the places from which enquiries came to the Canadian Engineer: "Upon receipt of your esteemed favor of the 18th inst., written in reply to my telegram, I telephoned to the Superintendent of Waterworks, at Ottawa, Ont., regarding their method of thawing water pipes with electricity. I was informed by the superintendent that the local electric company was engaged in thawing house service pipes with electricity, but that they had been unsuccessful in thawing mains. He stated that they had made several attempts, but up to that time, February 20th, they had not succeeded. We have continued our experiments in Ogdensburg and have been working upon one of our streets, where a stretch of about 1,800 feet of 6-inch cast iron main was frozen solid. The first section we undertook to open up was 700 feet in length, and in about three hours after the current had been turned on, we had water through it, leaving the hydrant open to maintain circulation. The next section was about 500 feet to a point where the main had been cut open in an attempt to thaw it with steam. Through this opening we were enabled to extract the core of ice which came along with the current, and thus obviated the necessity of keeping the electrical current on long enough to warm the water and thaw out the ice. We are now working on the last section, and expect to have the street open in a few hours. I beg to report that experiments have proven highly successful."

The Madoc Mining Co., Black Creek, Ont., made their first shipment of pyrites to Cleveland, Ohio, recently. They have put in an extra boiler, and intend starting more drills and cross-cuts.

NOVA SCOTIA ENGINES IN AUSTRALIA.

D. H. Ross, Melbourne, commercial agent for Victoria, South and West Australia and Tasmania, writes to his father at Amherst, N.S., as follows: "At the power house of the Perth Electric Tram Company, I was pleased to observe two 300-h.p. engines, manufactured by the Robb Engineering Co., of Amherst, Nova Scotia. These engines (Nos. 472, 473), have been working almost continuously eighteen and one-half hours daily, for over three years. The engineer in charge intimated the excellence of their work. The general manager and engineer of this railway is H. J. Somerset, formerly of Winnipeg, Man. He is also engineer of the Kalgoorlie Tram Company, and the chief authority on electric traction in Western Australia."

PREJUDICE AGAINST COMPANIES.

Editor, Canadian Engineer:—

SIR,—Your late article on "Municipal Plants" struck me as being somewhat unfair to companies. No doubt some corporations have invited that kind of criticism, but a great many companies have suffered severely from the prejudice in the public mind against all private enterprise, which is being fostered so much throughout Ontario by the press and otherwise, to the evident discouragement of capital. It is all very well for municipal undertakings to follow where private enterprise has shown the way, but municipalities never originate anything. If you discourage private initiative you must retard the progress of the country. No one objects to corporations taking all kinds of risks, but they should not make any more profits than a municipality who take no risk.

A. A. DION,
Genl. Supt. Ottawa Electric Co.

Ottawa, Feb. 22nd, 1904.

The Government of Nova Scotia has introduced a bill providing that men employed in coal mines, operating steam plants, man engines, hoisting engines, ventilating fans, must either hold certificates of service, the result of experience, or must pass an examination for competency.

By an invention of Dr. Fenton B. Turck, Chicago, the human stomach and internal organs may be examined for the presence of disease. The instrument consists of an optical and a carrying tube side by side, fourteen millimetres in width. Beyond the tip of the optical tube is an electric lamp, above which is a prism and reflector adjusted at an angle. The outer end is provided with the usual prism set before the objective. The other tube carries the gyromele cable, which may be curved in any direction desired, enabling the pylorus to be explored by a very soft, flexible cable covered at the end with wool tampon encased by a soft rubber finger cot.

The Canadian Engineer

VOL. XI.—NO. 4. TORONTO AND MONTREAL, APRIL, 1904. PRICE 15 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada, Great Britain and the United States, $1.00 per year, foreign, 6s. Advertising rates on application.

OFFICES—18 Court St. Toronto; and Fraser Building, Montreal.
Toronto Telephone, Main 4310. Montreal Telephone, Main 2589.
BIGGAR-SAMUEL, LIMITED, Publishers,

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 15th of the preceding month or if proof is desired, 4 days earlier.

CONTENTS OF THIS NUMBER:

METRIC MEASURES AND WEIGHTS.

It is well to hear both sides of a question of such great consequence as a change from the English to the metric system of weights and measures. The change would certainly involve great expense throughout the English-speaking world, especially in the engineering trades, and it is not likely to be undertaken unless manufacturers and merchants feel sure that the present cost will have its compensations in the future. On the last point British manufacturers and merchants appear to have made up their minds, considering the consistent advocacy of the metric system by nearly all the Chambers of Commerce and scientific institutions and expressed opinions of a majority of the members of the House of Commons, and, more noteworthy, by the action of that conservative legislative body, the House of Lords, which has passed the second reading of a bill to make the metric system compulsory in Great Britain in 1906. A bill is also before the United States Congress to make the metric system compulsory in that country in 1907, but it will not pass if the authors of a new book, called "The Metric Fallacy," represent the general opinion of our neighbors. The book is the joint work of Frederick A. Halsey and Samuel S. Dale. Mr. Halsey is an editorial writer on our ably edited contemporary, The American Machinist, a journal whose conductors advocate the metric system as strongly as Mr. Halsey opposes it. Mr. Dale is editor of The Textile World-Record, of Boston, and deals with the metric system as applied to textile manufacturing. The authors must have credit for arraying against the metric system nearly all that can be brought forward. The chief purpose of the book is to show that, while the metric system has been officially adopted in so many countries during the last hundred years, it has not completely displaced the local measures and those pertaining to particular trades, and that, therefore, it has been a failure and a fallacy. This is not a logical deduction. We must admit that the authors have proved clearly the persistence of local weights and measures in certain districts and in certain trades in metric countries: but this only shows the persistence of local customs and the extreme conservatism of artisans in particular trades, where the old guild idea still prevails, in the midst of changes that have affected the general trade and manufacturing interests of the country. It only shows that many people prefer to go on in the ruts their fathers made for them rather than take the trouble to learn a new way. Let us apply Messrs. Halsey and Dale's reasoning to other questions—Christianity, for instance. The Christian life was first fully explained and exemplified by Jesus Christ 1900 years ago. His doctrines have been nominally accepted by peoples speaking over 400 different languages and dialects; and advocates of Christianity claim that these principles form the best rule of life for all those people, and that such principles will be ultimately accepted by the whole world as the ideal system of social and political government. But as a matter of fact we find that after nineteen centuries the doctrines of Christianity have been rejected by thousands of individuals in each one of the so-called Christian countries, and that whole communities have continued from generation to generation in undisguised disregard of the fundamental laws of Christianity: therefore Christianity is a failure and a fallacy.

This appears to be the line of argument brought against the metric system: but, as we are sure that the authors of the "Metric Fallacy" would not make such sweeping deductions against Christianity because a majority of the citizens of Christian countries do not apply those doctrines to their own lives, so we are sure the average reader will not condemn the metric system just because certain trades stick to their local customs and do not appreciate the advantages of the newer system. Although the metric system was proclaimed in 1793, it was not till 1840 that it was made compulsory in France; and even now, after more than 100 years there are industries such as those of silk manufacturing in which old terms are still used in the factories. When we remember that this is the case in the land which originated the metric system, we need not be surprised to learn that local customs still persist in Germany, Turkey and other countries whose Govern-

ments have adopted metric measures. The value of Messrs. Halsey and Dale's book is that the facts they bring out will warn us against being over-sanguine of revolutionizing in a single generation all the trade rules and customs of the Anglo-Saxon world by the official adoption of the metric system. But this need not deter us from working for a change which will simplify in an immense degree the commerce of the whole world, and enable all nations to come together and understand each other, in some respects at least. The reasons we have faith in the metric system are, among others, that since it was adopted in France it has so commended itself to other nations that forty-four of them have, of their own accord, adopted it, and that as time goes on it is being used by a greater number of the people of those countries, to the gradual disuse of the local measures referred to; that it is already all but universal in the scientific world and in some special industries, such as the chemical industry, and that educationists as a body commend it for its greater simplicity and for the time that would be saved if it were universally adopted. As we have before said, the reason why the English-speaking people have not adopted the system before now is that heretofore they have held such a predominance in manufacturing, especially in the textile and engineering trades, that their measures have not only been understood by almost all the world, but have governed the system of measures even in metric countries. But the Anglo-Saxon peoples no longer hold a monopoly of manufacturing, and this fact is becoming thoroughly appreciated in Great Britain if not in the United States. It will be appreciated in the latter country as soon as its foreign trade reaches nearly the proportions of that of Great Britain.

TELEPHONES IN RAILWAY STATIONS.

The decision of the Board of Railway Commissioners in regard to the applications of the municipalities of Fort William and Port Arthur for permission to connect their telephone systems with the C.P.R. depots in the towns named is one which interests all other cities and towns which may in the future adopt either municipal or independent telephone systems. It is true that the permission asked is conceded, but the decision of Chairman Blair that compensation must be paid by the applicants renders the concession valueless. The claims set forward by the "Bell" that the voiding of this clause in their agreement with the C.P.R. would involve a loss of $100,000 is too absurd to be seriously considered for one moment. But admitting that such a loss was involved, in the opinion of able lawyers the agreement under which it is claimed is one which comes under the heading of restraint of trade; and furthermore, the clause inserted in the Railway Act last session was intended to give competitive telephone systems connection with railway stations, without compensation, this view being confirmed by all the members of the Railway Commission, the chairman excepted.

If it be true, as asserted by a correspondent in the Toronto World, that the stock of the New Brunswick Telephone Co. is practically in two blocks, one being held by the Bell Telephone Co. and the other by the chairman of the Railway Commission, that gentleman's decision in opposition to the view of the other members of the Commission should not be allowed to interfere with the carrying out of the obvious intention of Parliament in inserting the clause referred to in the Railway Act.

The companies are apparently desirous of compromising the present case by granting the facilities asked for without compensation, but it must not be overlooked that if the two municipalities consented to this, the whole matter would have to be fought out again by the next municipality or company establishing a competitive exchange. While it is most unfair under the circumstances to force the matter into the courts, now is the time that the matter should be finally settled. The very fact that the companies are anxious to compromise implies a doubt on their part as to the chances of the courts interpreting the clause in their favor.

It is surprising that a corporation like the C.P.R. should ever have agreed to a condition which, sooner or later, might result in loss of freight to their line and serious inconvenience to their shippers. The agreement with the Bell Telephone Co. was no doubt intended to provide for free transportation, in exchange for free telephone service, and as such was perfectly legitimate. It is difficult to comprehend that the railway company obtain any real advantage under this agreement, as it would appear that the value in train mileage for the transportation of the large staff of the Bell Telephone Co. would reach a much larger sum than that of the telephone service received in return. In this connection it is interesting to note that the Grand Trunk and other railways are introducing a system of long distance telephony over their telegraph systems. This will, no doubt, be more economical and satisfactory to the railway companies than any combination with the telephone monopoly.

The railway systems of Canada have been built very largely with the money voted by the people; that being so, the companies operating them should act in harmony with the needs of the public, and avoid entering into contracts intended to restrict the use of public utilities, or some day they may find that when they most need the assistance of the people it will be denied them.

INDEPENDENT TELEPHONY.

The subject of telephone competition has, during the past month, been a prominent factor in municipal politics, and the present indications seem to herald the advent of aggressive competition in more than one of our larger Canadian cities at an early date.

The city of Toronto has under consideration applications from two companies for a telephone franchise; the first offering services at flat rates of $36 per annum for business and $24 for residence; the second company promises service at $6 per annum and one cent per outgoing call, with a total maximum charge per annum of $35 for business and $15 for residence, with an increase to $40 and $20 respectively when 10,000 subscribers are reached.

Dealing with the first offer, although the rates proposed are lower than the present "Bell" charges, they are not low enough to effectually compete with the monopoly, or to meet the altered conditions existing in Canada. It is necessary to point out that when telephone competition began in the United States the "Bell" rates left such a wide margin between the amount charged and the cost of operation that independent promoters were enabled to fix the rates high enough to allow them to create a large body of watered stock and pay the cost of construction out of bonds. In other words, in most of the large cities the cost of the independent plant is covered by the bond issue, the share capital being what is known in slang parlance as "all velvet."

A few illustrations of the reductions effected in large American cities by competition will show that the independent rates are governed by the high "Bell" rates, and not by the actual cost of giving service. In Philadelphia rates were reduced: Business from $100 to $80, residence $130 to $48; St. Louis, business $120 to $60, residence $60 to $36; Indianapolis, business $70 to $40, residence $40 to $24; and Rochester, $94 to $48, residence $41 to $36 and 24.

In the January Canadian Engineer a list was given of a number of over-capitalized independent companies which bears out the contention now made. One of the companies referred to was the Columbus (Ohio) Telephone Co. with an average capital and bonded indebtedness for 6,277 subscribers, of $216, with no toll lines, charging rates of $40 and $24. In contrast with this the Citizens' Company, of Grand Rapids, Michigan, with an average capital for 12,367 subscribers and 2,000 miles of toll lines, of $96 per subscriber, having no bonded indebtedness, can afford to give rates of $30 and $20 in the city, down to as low as $9 in villages, and has paid 8 per cent. per annum since its inception in 1896, and has moreover a surplus of over $50,000. The difference in rates between these two cities may be accounted for in the fact that while Grand Rapids pays dividend on capital used in building the plant, Columbus has to find dividends on $705,000 capital in the promoters' hands, and interest on $650,000 bonds, with which the system was constructed.

To come back to the proposed competition in Canada, while it is admitted that the "Bell" rates are excessive, it must also be remembered that they are not as high as the charge in cities of equal size in the United States before the advent of competition. There is, therefore, no margin for the inflation of capital and bonding of plants; hence no proposition can hope to be successful unless it is based on the earning of dividends on stock which is represented by actual value in plant. In other words, there must be no "water."

The City Engineer of Toronto, in an estimate of the cost of constructing and operating a municipal telephone system of 10,000 subscribers, gives the cost of installation at $1,200,000; that of operation, including maintenance, depreciation, interest and sinking fund, as $205,000 per annum. The revenue, at $30 for business and $18 for residence connections, was estimated to produce $252,000. These figures would seem to indicate that the proposed rates of $36 and 24 include provision for a certain proportion of water.

The second offer made to Toronto is one that is likely to prove more successful in competition with the "Bell," inasmuch as a subscriber having two phones is not burdened with the payment of two full subscriptions, the second phone costing him only a fixed rental of $6, beyond which he is only called upon to pay one cent per call when speaking to subscribers not on the "Bell" system. In other words, he gets full value for every cent expended, and is not paying full rate for a second phone, the greater part of which service may, for a time, be obtained on the old system. Such a system not only overcomes the disadvantage of paying for two telephones, but it should result in a more rapid growth of the independent exchange than the old method of charging flat rates. The mayor of Toronto has declared himself in favor of the offer, subject, of course, to the necessary provisions to ensure the proper performance of the terms of the franchise. The decision of the Toronto City Council will be awaited with interest by several cities which are strugglng with the telephone problem, including Ottawa, Brantford, London, Kingston, St. Thomas, Ont., and St. John, N.B. There is no doubt that if Toronto adopts [illegible] telephony, its example will be followed in [illegible] places, and there is every reason to pre[illegible] result will be as successful as in the United [illegible] during the past few years.

The Bell and its supporters loudly [illegible] against the evils of telephone competition and the disadvantages of dual telephony. Evidence has, however, been obtained of a most conclusive and irrefutable character on this subject. The independent subscribers of 189 exchanges, spread over seventeen of the United States, were recently circularized on this matter. Five questions were submitted, and the following is a summary of the replies: Has competition resulted in better telephone service in your city? 1. By an improved service on the part of the Bell Company. 2. As given by the independent company. Answers: 1. Yeas, 982; nays, 154. 2. Yeas, 1,245; nays, 26. Has competition increased the number of subscribers? Answers: Yeas, 1,261; nays, 8. Has competition brought about greater civility and attention? Answers: Yeas, 1,222; nays, 37. Have rates been reduced by competition? 1. By the reduction of Bell rates. 2. By lower independent rates. Answers: 1. Yeas, 1,238; nays, 45. 2. Yeas, 979; nays, 120. Would it be preferable to return to the conditions prevailing before competition? Answers: Yeas, 14; nays, 1,245.

The present telephone service is altogether inadequate to the needs of the Dominion. There is a demand on the part of the people for more telephones. The existing subscribers are universally dissatisfied with the present service, and would welcome any means of providing them with a better and cheaper one. Competition is the one means of supplying the people's need. It, therefore, only remains to organize local companies, as has been done in Toronto, and for the citizens to give such systems their loyal support in preference to the "Bell" monopoly. If this policy were pursued with energy and determination the people would soon have the country covered with a network of exchanges and toll lines in every way equal to the independent service in the United States.

* * *

—We are glad to learn that the proposed boiler inspection act relating to agricultural engines and boilers in Ontario has been withdrawn. The mover, Mr. McKay, has had the good sense to realize that the measure, if passed, would have done injustice to many a man competent to run a threshing machine engine, while at the same time it would have left a clear loophole of escape for those really responsible for the accidents and loss of life due to bad workmanship and materials, apart from accidents due to the ignorance of those operating such machinery. We would suggest to Mr. McKay a study of the British Acts dealing with boiler explosions and accidents to machinery, and that at a later session he introduce a broad measure founded on those Acts, and applying to all classes of machinery and engine accidents. This Act, carefully framed, would, we feel sure, prove to be so just and effective that it could with safety be recommended to all the other Provinces as the basis of a Dominion Act. Such legislation, it appears, falls within the sphere of the Provincial Parliament, but by mutual agreement of the Provincial Government a Dominion Act, based on the proved efficiency of the Ontario Act, could be accepted by all the other Provinces. The advantage of delegating such authority to the Federal Parliament is that the machinery for carrying it out would be simpler, cheaper and more uniform in its operation. We be-

lieve most readers will agree that the British law as summarized in last issue is the best in the world, because so evidently founded in equity and common sense, and the remarkably low ratio of accidents in the Mother Country, compared with countries like the United States, Canada and European countries, points to that law as a model for Canada.

MONTREAL, THE GREAT ELECTRIC POWER CITY.

Alton D. Adams in Electrical World and Engineer.

THE CHAMBLY POWER HOUSE.

(Concluded.)

At Chambly two sets of bus-bars are provided at the switchboard for the two-phase, 2,200-volt current from the generators. The low-tension side of the step-up transformers there may be connected with either of these two sets of bus-bars by means of motor-operated oil switches. Each of the eight main generators may be connected by its switch with either set of these bus-bars, but these generator switches are manually operated. The generator switches, like those for the transformers, are of the oil type, with a separate brick and stone compartment for each pole. To provide air under pressure for the ten air-blast transformers, four blower sets are employed, each consisting of a 40-h.p. 550-volt induction motor, direct-coupled to a pair of blowers, one at each end of the motor shaft.

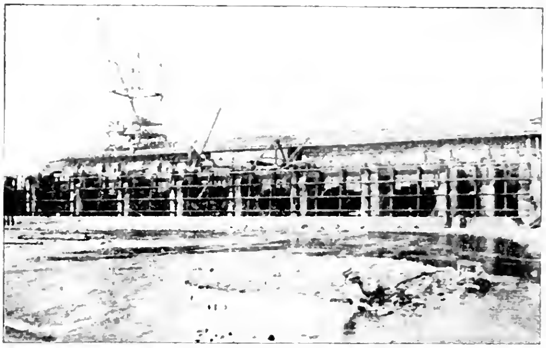


Fig. 1.—Front View of Chambly Power House.

Of the eight alternators at Chambly, four were made by the General Electric Company and are rated at 2,200-K.W. each, at 2,200 volts, two-phase. The other four alternators are of the Stanley make, and each has a capacity of 2,000-K.W., at 2,200 volts two-phase. All of these generators operate at a frequency of 63 cycles per second, this number of cycles having been adopted as a compromise between 60 and 66 cycles both of which frequencies were formerly found in the water-power stations that now contribute to electrical supply in Montreal. By lowering the speed of revolution a little for some generators and raising it a little for others, it became possible to operate the several water power stations in multiple at 63 cycles per second. Each of the eight alternators at the Chambly station is direct-connected to the horizontal shaft of four McCormic turbine wheels mounted together. Each of these turbines is 51 in. in diameter, and under the available head of 31 ft. of water operates at about 152-R.P.M. Two exciters, rated at 300-K.W. and 125 volts each furnish current for the magnet coils of the alternators. Each of these exciters is direct-connected to the horizontal shaft of two 27-in. turbine wheels, which are rated at 450-h.p. and operate at 250-R.P.M. under the water head of 31 ft. The set of wheels driving each main generator and each exciter is regulated in speed by a Lombard governor. Four of the above alternators, those made by the General Electric Co., have stationary armature coils and internal revolving magnets. In the case of the four Stanley alternators the armature coils are stationary, but this is also true for the single magnet coil of each machine, and the only revolving parts are the masses of iron that complete the several magnetic circuits. Eight alternators and the two exciters form a single row that extends almost the entire length of the Chambly power house, and their shafts are all parallel. As may be noted from the above, the total rated capacity of alternators at Chambly is 16,800-K.W.

The room thus occupied by the generators is about 277 ft. long and 28 ft. wide. At nearly the same level with the generator room and on its upstream side, but separated from it by a water-tight wall of concrete 4 ft. thick, are the compartments for the horizontal turbine wheels. The shafts of the main wheels are located 17 ft. above the tail-water level, and each shaft passes into the generator room through a water-tight bulkhead of cast iron. From each pair of 51-in. turbine wheels, of which there are two pair on each shaft, a draft tube of 10 ft. 3 in. diameter passes down to the tail water. Top, bottom and sides of the wheel chambers are all of concrete, and the roof of these chambers rises on its outside to an elevation of 19.5 ft. above the floor of the generator room. The concrete floor thus formed by the roof of the wheel chambers is about 20 ft. 4 in. wide between the plain of the wall on the upstream side of the generator room and the upstream wall of the upper part of the station. This elevated floor over the wheel chambers is about 305 ft. long and carries the switchboard in its central portion and the transformers.

Underneath that particular portion of this elevated floor that is nearest to the generator room, parallel to that room, and directly over the water wheels that are nearest to the wall that separates the generator room from the wheel chambers, there is a tunnel 6 ft. wide and 6.5 ft. high. Into this tunnel, which runs beneath the switchboard and the transformers, cables between the switchboard, transformers and generators are brought. Along the top of the concrete wall that separates the generator room from the wheel chambers there is a row of steel columns that extend to the lower cord of the roof trusses. These columns serve to support a track for one end of the travelling crane, and the track for the other end of this crane is carried by steel columns along the downstream wall of the station. This crane is provided with electric motors for both hoisting and conveying purposes, and sweeps the entire generator room.

In effect the water power station at Chambly forms a part of the dam across the Richelieu river by which the head of water is maintained. This dam, considered as a whole, starts from the west side of the river in a direction approximately at right angles with the bank and continues thus until it is more than half-way across the stream. Then the dam makes a turn at approximately right angles, and continues down stream nearly parallel with the east bank for perhaps 1,000 ft. At the end of and at nearly right angles to this second part of the dam comes the power house, which extends to the east bank, and thus completes the dam. About

Fig. 2.—View Up Stream from Power House.

30 ft. of the length of the water power station rests on the bank, and the remainder of its 308 ft. of total length is built up from the bed rock of the river. Up and down stream the width of the station foundations is 82 ft., and this narrows to about 72 ft. at the floor level of the generator room and the wheel chambers. On a level with the top of the arches over the wheel chambers, whence rises the upper part of the wall on the upstream side of the station, its width shrinks to 51.5 ft. over both outside walls. The steel roof trusses span these walls and the lowest cords of these trusses are 34.5 ft. above the floor of the generator room. Foundations of this power station are of concrete up to and including the floor of the generator room on the downstream side, and

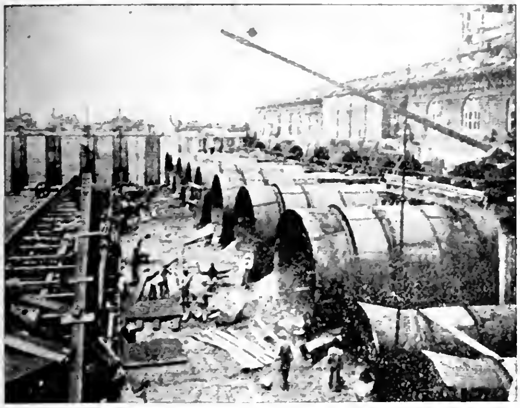


Fig. 3.—Setting the Penstock Tubes.

up to and including the roof of the wheel chambers. These concrete wheel chambers have a total length of 42.5 ft. up and down stream, and of this length 20.5 ft. is outside of the upstream wall of the top portion of the power house. Above the concrete foundations the walls of the power house at Chambly are of brick with vertical steel columns set into them to support the roof trusses. Beneath the upstream side of the power house there are ten wheel chambers for the eight sets of large wheels and two sets of smaller ones. Beneath the downstream side of the power house there are seventeen archways through which the draft tubes of the several sets of wheels pass between the wheel chambers and the tail water.

Each pair of the 51-in. turbines has its own draft tube of 10 ft. 3 in. diameter, and each pair of 27-in. wheels has a draft tube of approximately 5 ft. diameter. There is thus one archway under the generator room for each of the larger draft tubes, and also one archway for the pair of smaller tubes.

At the upstream end of the wheel chambers is the steel rack to keep ice and other floating objects away from the wheels. This rack is 269 ft. long and has a vertical height of 23.5 ft. From the foregoing it may be seen that the flow from head to tail water is directly underneath the power house from the upstream to the downstream side. As at first constructed, the wheel chambers contained the open turbines, but this has recently been changed and a steel penstock with gate has been provided for each set of wheels. Near the river end of the power house a set of waste gates in the dam or forebay wall, through which water may be drawn off into the main channel of the river, are located. The long portion of the dam running up and downstream, as well as the shorter portion that crosses the main channel, was originally built entirely of concrete, save that small iron rods were buried at intervals in the mass to increase its strength. Results of this construction have not been entirely fortunate. Some time after the completion of the dam, that portion containing the waste gates, near the power station, gave way and had to be rebuilt. On December 1st, 1902, that portion of the dam across the centre of the main river channel broke loose and moved some rods downstream in a mass, leaving a clear gap from the bed of the river up for the escape of the water. This detached portion of the dam, bristling with the iron rods that were intended to hold it tog[illegible] alone in midstream, a monument to its builders. [illegible] this break has only recently been completed, and [illegible] great loss has been sustained through inability t[illegible] the 16,800-K.W. capacity of generating equipment at th[illegible] station. While a new section of dam was being [illegible] in the gap at midstream, a wide apron of timber and stone has been laid along the side, next to the main river channel, of that part of the dam that extends for more than 1,000 ft. up and down stream. As this very large piece of concrete dam work stands, whether from improper design or poor materials, it may fairly be said to illustrate to a conspicuous degree the way not to do it.

Lachine Rapids, on the St. Lawrence river, between the Island of Montreal and the south bank of the stream is the site of the second water-power station owned and operated by the Montreal Light, Heat and Power Company.

At this station the head of water on the wheels, about 16 feet, was obtained by an unusual construction. The St. Lawrence river at this point passes through a long series of rapids with no great fall in any one place. To render a portion of the water available for power purposes, a large break-water, perhaps a mile in length, was constructed up and down river through the rapids between the Island of Montreal and the south bank, but nearer the former. At a point nearer to the downstream than to the upstream end of this breakwater, a power station and dam was thrown across that portion of the river between the breakwater and the Montreal bank. Water in that portion of the St. Lawrence between the breakwater and the Montreal shore must obviously pass through the power station on its way downstream, and in thus passing it is made to fall through a long row of water wheels. The head of water being so small, only 16 feet, it was necessary to devise some way in which a reasonable speed of revolution could be obtained for the electric generators. The plan adopted was to use single vertical turbine wheels, and to drive each generator direct connected to a long horizontal shaft, which is in turn connected by bevel gears with the vertical shafts of six turbine wheels. As originally designed, each horizontal shaft with its connected generator had a speed of 180 revolutions per minute. Each of the 51-inch vertical turbine wheels geared to this horizontal shaft had a speed of about 77 revolutions per minute.

The total capacity of alternators now at the Lachine station is 6,000-K.W. Four exciting dynamos are provided for

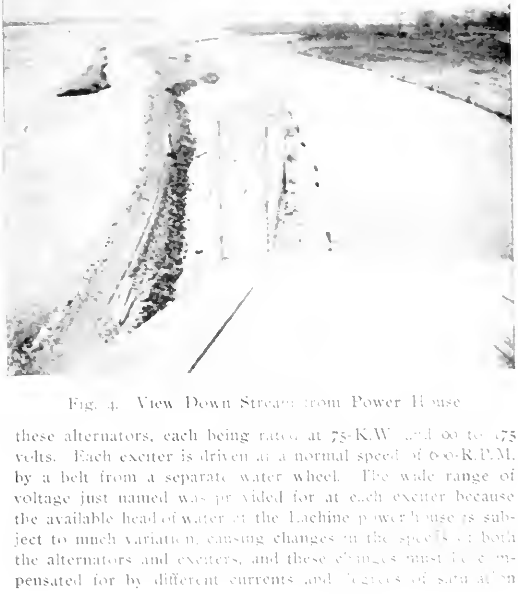


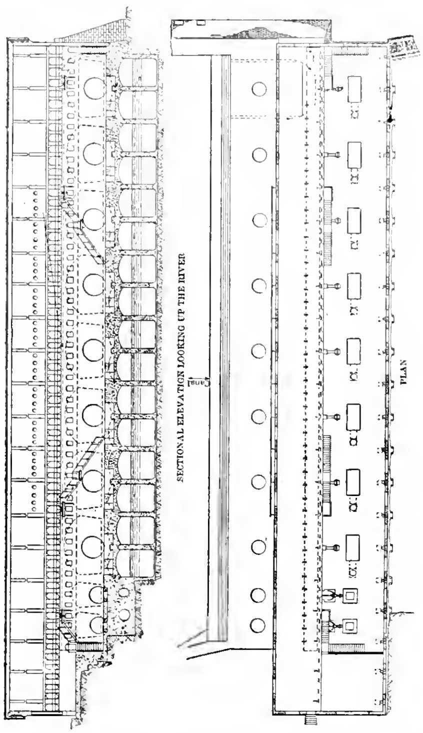
Fig. 4. View Down Stream from Power House

these alternators, each being rated at 75-K.W. and [illegible] to [illegible]75 volts. Each exciter is driven at a normal speed of [illegible]-R.P.M. by a belt from a separate water wheel. The wide range of voltage just named was provided for at each exciter because the available head of water at the Lachine power house is subject to much variation, causing changes in the speeds of both the alternators and exciters, and these changes must be compensated for by different currents and degrees of saturation

in the alternator magnets, in order to maintain a constant alternating voltage. With a view to these changes of saturation in the magnets of alternators, these magnets were so designed that at full speed and voltage their degree of saturation is below the usual figure.

The distance from the Lachine power house to the substations in Montreal is so short that no step-up transformers are employed to raise the voltage of 5,000 developed in the armature coils of the alternators, and energy at this pressure is delivered to overhead lines for transmission to the McCord street and the central sub-stations. These lines are carried in large part by steel poles with wooden cross arms. In this case the steel poles are built up of structural shapes, and are erected from 100 to 125 ft. apart, as might be done with wooden poles.

Up to 1902 the transmission line between the water power plant at Chambly and the central sub-station in Montreal was operated at 12,000 volts, and in this line there were 12,000 ft. of cable in pipes and conduits under ground and under water. This 12,000 ft. of cable was all of the single-conductor type, conductor consisting of 37 strands equal to 00 copper



wire. In each cable the stranded conductor was insulated with vulcanized rubber compound to a thickness of ¼-in. and then with two layers of rubber tape. Outside of the tape came a seamless covering of lead 3-32-in. thick. This cable was installed in January, 1898, and continued in use until some time in 1902.

The lead sheath of the cable contained 3 per cent. of tin, but had no outside coating or covering. A part of this cable was laid in creosoted wooden boxes, and a part in iron pipes. During the entire four years that this cable was in use carrying a current of 12,000 volts, two-phase, there was no failure. Furthermore, during 1½ years of this time, the only method used to protect the cable from lightning discharges was that of barbed wires strung on the poles that carried the overhead conductors, and connected to a ground wire at each pole. As the territory between Chambly and Montreal is subject to frequent and severe thunderstorms, this freedom from injury to the cables is of interest as bearing on the protection afforded by barbed wires against lightning.

On the 25,000-volt transmission circuits between the power house at Chambly and the central sub-station in Montreal switching is done only when there is no load. All switching of transformers under load is done with their low tension coils, and this has given satisfactory results. No fuses are employed in these high-tension lines. Operation with a grounded neutral to protect transformers has led to no trouble with the transmission circuits themselves or with nearby telephone wires. In spite of the high voltage on this line the insulators have given no trouble by puncturing, and no arcs have started between the wires. Telephone service with its wires on the same poles with the power circuits is satisfactory, but has been found more subject to noise in wet than in dry weather, and with heavy than with light current on the line. No one has been hurt by electric shock while using a telephone. Repairs on the transmission circuits have been made at all times of day and in all kinds of weather without injury to workmen, but during such repairs no energy is sent over the wires on the poles where work is being done. The transmission line is patrolled three times a week.

For the purpose of testing the new transformers at the Chambly plant and the sub-station, and also the two 25,000-volt transmission lines, a rather novel plan was adopted. At Chambly, near the power house, three 40-ft. cedar poles were fastened together in the form of a triangle, and from each of the three corners a plate of iron 2½-in. wide, ⅛-in. thick, and several feet long was suspended in running water, so that the plates were about 50 ft. apart. The three conductors of one transmission circuit were then connected respectively to these three iron plates. At the central sub-station in Montreal the other ends of these same conductors were connected to the high-tension coils of a group of transformers. The other transmission circuit was connected to the 25,000-volt coils of a group of transformers at the Chambly power house, and to the high-tension coils of a group of transformers at the central sub-station. The 2,400-volt coils of the two groups of transformers at the sub-station were also connected. In this way energy delivered to the group of transformers at Chambly was transmitted to the sub-station, through the two groups of transformers there, and then back over the other line to the metal plates in the water at Chambly.

NORTH-EASTERN CANADA.

BY HENRY HOLGATE, C.E., MONTREAL.

To the average Canadian and even to the tourist, the head of navigation on the Saguenay river is the "ultima thule" of eastern and north-eastern Canada, and the popular holiday trip up the Saguenay has for its greatest inducement the rugged wildness of the country, thoroughly impressing the visitor that unless he wishes to live in a tent, he had better not venture any farther eastward.

When one sees for the first time Tadousac, at the mouth of the Saguenay, and realizes that this was established as a settlement for commercial purposes in the year 1603, before the founding of Quebec, and notes the apparent desolation in all the surroundings, he naturally reasons that the tributary country is wanting in the necessary natural resources which tend to material development, and the thought may arise, did the intrepid and energetic early French and English explorers in their intense anxiety to discover the secrets of the west, overlook what they passed on the way up the St. Lawrence, for they certainly did not leave us any clear information of the country north and east of Tadousac.

No doubt these early explorers did well in pressing west. and even in the discoveries they made there, the world was slow in realizing the fact, that the wilderness then made known was a veritable promised land, the outcome of which has been the firm establishment of a vast food producing area not dreamed of fifty years ago, and which has been brought so close to the world's markets by the development of systems of transportation, that its products are a source of such wealth to its people as promise soon to place their country in a position relatively stronger than other parts of Canada, and in a world-wide sense infinitely valuable.

So much for a so-named wilderness, and what can be developed from it, given at least three factors: 1st. Natural

resources; 2nd, desirable immigrants, and 3rd, what will surely follow, adequate systems of transportation. Those who sail from Montreal or Quebec for European ports may think that they are more or less familiar with the St. Lawrence River and Gulf, but if they examine a map they will realize that their course is along the south shore, and but a dim, blue outline of the north shore is visible, and that only for a few hours, for the river broadens into the Gulf on such a grand scale that at a distance of 200 miles below Quebec. the river is 70 miles wide and all signs of land to the north soon disappear. The only way to get an idea of the nature of the north shore is to take one of the small local steamers plying along the coast, or to make the trip in a schooner, and a good navigator must be fortified with a vast amount of local knowledge to pilot his craft safely, for while the chief dangers to navigation have been provided with warning signals by the Government, there are many places that can only be rendered safe by like treatment, and no doubt the Government will keep pace with the improvements going on along the coast, and anticipate the needs of those engaged in business there.

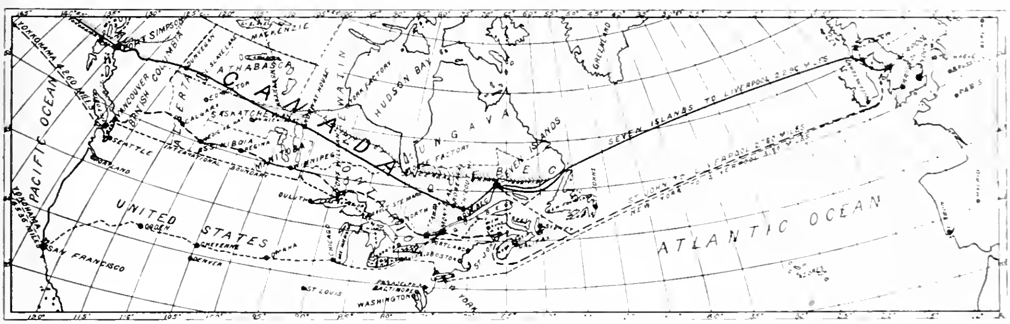
The history, such as it is, relating to this country in the early period, is well known to your readers. Biarne, the Norseman, having been accredited as being the first European visitor in the year 990. Leif, Szkolney, Cabot, Denis, Aubert, Cortereal, Cartier, Roberval and Champlain have assisted in making known this vast area, or at least the southern part, while Martin Frobisher, John Davis and Henry Hudson explored the northern limits.

In 1661 a French expedition reached Hudson's Bay, by way of the Saguenay and Rupert rivers, and in 1663 the Indians from Hudson's Bay began trading with the French at Quebec. In 1669 what is now the Hudson's Bay Company was chartered, and their first trading post was established at Rupert River, on Hudson's Bay, in 1670. The voluminous relations of the Jesuits describe many wanderings into this vast area undertaken by these fearless pioneers. In 1685 a mica mine was worked on the East Main river, and the history of the Hudson's Bay Company is worth the study of those interested in the very early development. In 1703 the French had more knowledge of the interior than had the English, as evidenced by the maps published, but the best information was very crude and inaccurate. In 1763 the southern and eastern coasts were placed under the jurisdiction of Newfoundland, and ten years later Canada resumed jurisdiction there. In 1809, Newfoundland again assumed part of this tract, and in 1876 the extent of jurisdiction was defined, and limited to the eastern coast line. For those who desire more minutely to follow the history of the exploration of this country, we would refer them to the reports of A. B. Blaiklock, 1860; Henry Yule Hind, 1862; Dr. A. S. Packard's "On the Labrador Coast," 1864; L. M. Turner of the Smithsonian Institute, 1886; R. F. Holmes, Royal Geographical Society, 1887, and to the American Geological Society Bulletin, Vol. 24. There are valuable reports also in the office of the Geological Survey of Canada dating from 1863, the later ones by A. P. Low being interesting and comprehensive.

The surveys and explorations made under the direction of the Crown Lands Department of Quebec contain detailed information of practical value, and embrace good reports relating to timber, minerals and the rivers of the country. Conditions [illegible] not [illegible] an agricultural [illegible] otherwise after all, [illegible] already [illegible] eminently suited for [illegible] of staple [illegible] ally, they will be [illegible] developed [illegible] does not mean that [illegible] hardy crops, which [illegible] territory north and [illegible] the Saguenay river to James [illegible] miles, and of which area [illegible] the province of Quebec. The area comprising the [illegible] watershed is about 180,000 square [illegible] area discharging into the River and [illegible] St. Lawrence.

This immense watershed supplies [illegible] rivers affording in their course southward a great many water-powers varying in capacity from 1,000-h.p. to more than [illegible] at one development site. The timber yielding area is practically confined to this southern watershed, and although it is but a small proportion of the total area of the whole territory, it is nearly four times larger than the State of New York. The timber consists principally of several varieties of spruce, balsam, and white birch, tamarac being found in the eastern portion. The distribution of the streams and rivers in the southern watershed is such as to render all of the timber accessible, so that when the market demands a rise, the whole of the timber will be available. The existence of the water-powers is a feature tending to encourage development in preference to localities not so favorably situated, especially will this be true of such industries as the manufacture of wood pulp and its products. Several companies have already appreciated the conditions here afforded, and have begun development on more or less large scale, but the field is so great, that development may be said hardly to have begun. The whole country is well supplied with minerals, but wants further explorations to make more fully known its resources. Mr. Low states that the occurrence of gold, copper, nickel and pyrites, render the tracing of these areas of great importance, and we can rely upon the Geological Survey of Canada following this up. The known deposit of iron ore are very large, and will be of great value, depending on transportation facilities, and the advancement of the use of electricity in smelting. Owing to the tremendous water-powers available for the production of electricity, this locality offers unmatched facilities for industries of this nature, as soon as the commercial features of electric smelting shall have been solved. The deposits of magnetic iron sand along the coast, have for years attracted attention, but have not been used to commercial advantage yet, and no doubt await more favorable means of reduction and treatment on the spot, for, owing to the difficulty of gathering and transporting, their great value will lie in local treatment.

At present there is no railway east of the Saguenay river, and internal development cannot progress without such facilities for transportation, and until a railway is built, the products must find their way to the coast by the numerous rivers, thus limiting the usefulness of the products of the interior practically to those of the forest. As, however, many of the large deposits of iron ore are close to the coast, and as the greatest water powers are there also, it becomes more a question of transportation by water that concerns the immediate questions of development.



The Shortest Route—Europe to the East. Seven Islands—Port Simpson.

For navigation, the coast is provided with numerous natural harbors, and many bays that can be rendered safe for shipping purposes by the construction of protection works more or less extensive. One of the best natural harbors in the world exists on this coast, that of the Bay of Seven Islands, for which nature has done her best in producing something better than anything else in America. But when nature turned over this harbor to us, she "kept a string on it," for she closes it up nearly every year with ice. I say nearly every year for there have been years when but little ice has been seen in the harbor, and from what can be ascertained from personal observation and enquiry, navigation could be maintained all the year round, with an ice-breaking ship of very modest proportions. The question of navigation all the year round from and to Seven Islands appears to be one of harbor facilities only, for once outside, there are no obstructions not even from the ice, at any season of the year, except such as may arise from ice coming through Belle Isle, and this is, of course, common to all navigation in the Gulf, and occurs in the early summer months.

From the facts before us, we must look upon the development of such a harbor as that of Seven Islands as not only a possibility, but a probability. It becomes an objective point farther east than Quebec as an outlet for trans-Atlantic commerce, and in the regular order of progress must sooner or later be reached by a railway from the West.

Geographically considered, Seven Islands occupies a favorable place, its latitude is 50 deg. 13' N. and its longitude 66 deg. 24' W., and is about 200 miles farther south than Liverpool. The following table of distances may serve to illustrate its relative location more clearly, taking Liverpool as the point of destination:

Sailing Distance from	Miles.
New York	3,105
Boston	2,807
Portland	2,789
Montreal	2,778
St. John	2,700
Quebec	2,633
Halifax	2,450
Seven Islands	2,304

Seven Islands is 800 miles nearer Liverpool than is New York. The objections to the opening up of a new trade route are always strongly urged, and sometimes facts are ignored which tend to strengthen the claims of the new route for recognition, so it is well to state the main facts in its favor and these are, the shortest sailing route across the Atlantic, the coast is accessible all the year, and the harbor itself is magnificent. These are certainly good things to start with. Who will develop this new route?

It must also be borne in mind that having the rail terminal at Seven Islands also shortens the length of rail haul from the West if a northerly trans-continental route be built, and as Canada is now served with a trans-continental rail route to the south, it will be a matter worth careful consideration for any future trans-continental route, as to whether Seven Islands should be the terminus. Northeastern Canada has received in the past but scant attention, yet as there are certain elementary conditions which render it valuable as a producer, and as a channel for the products of the West, it must at no distant date receive the attention of the manufacturer, and of those interested in transportation in its larger sense, and this is emphasized by the fact that having Seven Islands as the eastern railway terminus, affords a route very considerably shorter than any existing trans-continental railway. A short study of the accompanying map clearly shows the comparison between the routes.

(To be continued.)

It is stated that the Dominion Coal Co. will extend their general machine shop at Glace Bay, C.B., this spring. Also that a large dam will be constructed on McAskill's brook, a reservoir built, and an improved water system provided around the collieries.

TELEPHONE AND TELEGRAPH.

The long-distance telephone line between Sydney, C.B., and Halifax, N.S., was formally opened on March 15th by an exchange of messages between the Mayors of Halifax, Sydney, North Sydney, Sydney Mines, Glace Bay and Louisburg.

It is proposed to erect an independent rural telephone system in Ontario, from Thornbury and Clarksbury up to the Tenth Line, taking in Heathcote, Redwing, Ravenna, and Kolapore, with possible extensions to Feversham, Duncan, and Kimberley.

The C.P.R. Telegraph Co. will extend their system in the North-West this year, and will construct additional circuits between Quebec, Montreal, and Winnipeg, and between Peterboro, Toronto and Windsor. When completed, the system will comprise 66,000 miles of wire.

The Bell Telephone Co. will erect new premises at Winnipeg, Man., to accommodate 10,000 telephones. Extensions will also be made from Morris to Emerson, via Letellier, St. Jean and Dominion City. A new exchange will be erected at Carman, and the Calgary exchange enlarged.

RAILWAY NOTES.

The Edmonton town council have granted a 30-years' street railway franchise to Mr. Tretheway. The system is to be in operation by September 1st, 1905. A deposit of $25,000 is required. The company is exempt from taxation for ten years, after which it will pay, in addition to taxes, $20 per car per year, and 5 per cent. on its gross earnings until they reach $500,000, when the percentage will be 8 per cent. The town has the right to acquire the system by arbitration when the franchise expires.

The Sydney and East Bay Railway Co. has been incorporated to build a road from Sydney, C.B., to Johnstown Harbor, Richmond County, with power to acquire mines, hire or construct ships, barges, ferries, etc.; build hotels and establish summer resorts on the Bras d'Or lakes. The route will be via the south side of East Bay, with a branch from the head of East Bay to Eskasoni, on the north side. The line will not enter Sydney, but will connect with the Intercolonial near Gibbons' Bridge, on the Sydney river. It has not been decided whether the motive power will be steam or electricity. A. C. Ross is the chief promoter.

The G.T.R. report for the half year ending December 31st shows gross receipts of £3,138,468; increase, £326,590; passengers carried, 5,150,073; increase, 451,423; tons of freight and live stock, 5,738,702; increase, 590,172; working expenses, £2,214,084; net receipts, £924,000; net revenue charges half-year, less credits, £526,000; balance, £398,400. Maintenance and equipment increase, £52,485; cost of transportation increase, £179,616, due to increased cost of materials and higher wages. Total increased expenditure, £239,263. Surplus, including balance of £5,500 from June last, £404,300. Full dividends for half-year on 4 per cent. guaranteed stock and first and second preference stocks, and dividend of 2 per cent. for the third preference stock have been paid. Balance carried forward, £2,000.

The irrigation scheme of the C.P.R., in the North-West, will be under the direction of J. S. Dennis. It will cost $2.75 per acre, and will affect five million acres. In India, where the British Government has carried on for years extensive irrigation works the price has been $6.65 per acre. $127,000,000 has been spent in the work, resulting in the reclamation of 19,000,000 acres. The results are much more valuable in a densely populated country, like India, than they will be in Canada for a long time to come. In India the irrigated soil produced seventy times as much as an equal area of dry soil. The C.P.R. looks forward to a profitable return, especially through the cultivation of vegetables and other garden truck. Mr. Dennis will commence in the spring the digging of a large central canal through the territory which is to be irrigated.

THE CANADIAN MINING INSTITUTE.

The annual meeting of the Canadian Mining Institute was held at the King Edward Hotel, Toronto, March 2nd, 3rd and 4th, under the presidency of Eugene Coste, with a good attendance. Unfortunately, the meeting was clouded by the news of the death, on February 29th, of B. T. A. Bell, secretary of the Institute.

At the first session the reports of the officers and council were presented, showing a membership of 435 and cash balance in hand of $2,912.73.

Resolutions of sympathy with Mrs. Bell were passed, and Messrs. Coste, Brown and Major Leckie were appointed a special committee to represent the Institute at Mr. Bell's funeral. It was also decided that the annual dinner be cancelled. Messrs. Obalski, Hobart and Mills were appointed scrutineers of the ballot for officers.

Nine papers were submitted by student members. The Committee of Award in the Geological Section recommended that the cash prize of $25 be given to S. H. Boright for his paper "On the Geology of the Northern Portion of the Boisdale Hills. Anticline." In the Mining Division the committee recommended that Norman W. Parlee be given a similar cash prize for his paper on "Rock Drilling and Blasting." None of the papers being deemed to have sufficient merit to warrant its award, the president's gold medal was not given.

The afternoon session opened with the president's address, in which he expressed his pleasure that the Institute was meeting in his native Province. The membership tended more and more toward the West, 108 Ontario members, 68 from British Columbia, and 11 in the Yukon having to be set against 69 from Quebec and 30 from Nova Scotia. He outlined the historical development of the Institute from the various provincial mining societies. The Government had recognized the value of their publications by an annual grant of $3,000. They were the only body in the Dominion upon whom it devolved in the terms of the charter to take "concerted action in such matters as affect mining and metallurgical interests in Canada." Their recommendations to the Government had invariably been accepted. Three notable instances were adduced. Export duties on nickel ores and matte were not imposed, though approved by the Ontario Government in 1899. Taxes on nickel and copper ores and matte had been recognized as an interference with the industrial independence of these interests, which was essential to their development. The reduction to 2.5 per cent. of the export gold duty in the Yukon was a third point in which they had used their influence. They had helped to defeat the alien labor and eight-hour laws in British Columbia. Good roads and mining legislation in the Yukon and the free listing of gold, dredging and mining machinery were other matters in which they had acted. The president then discussed at some length the possible aid to mining which could be rendered by the Government. He called attention to the fact that, notwithstanding the great growth of the mining industry, the Geological Survey appropriations had not been increased, and its operations had been restricted by limited means. He advocated a great extension of the work now done; whether such extension could best be made by the establishment of a new bureau, or by extending the organization of the Geological Survey, would be a matter of detail. In either case the proposed bureau ought to contain several branches, as the general administration; the geological survey proper; the topographical and geographical survey; the preparation of reports and monographs on mining districts and mineral deposits; the collection of statistics; economic results and commercial facts bearing on the mining interests—which would be closely connected with the statistical bureau; and a department interested in metallurgical and chemical work. The work of such a department would not interfere with the mining rights and the making and administering of mining laws in the several Provinces. To them would be reserved the selling and leasing of mineral lands, the inspection of mines, the keeping of maps, plans and records; the collection of dues, license fees, taxes or royalties; the collection of statistics; the fostering of technical education, public assay offices, roads and transportation in mining districts; custom concentration and reduction works; deep sinking and testing deposits; issuance of [illegible] mineral districts, etc.

A paper was read by Frederick Keffer [illegible] the Boundary District, B.C." It supplemented [illegible] presented at the 1902 meeting, describing the [illegible] mining and handling ore recently made. This was [illegible] by a paper on "The Rossland Ore Deposits," by [illegible]. W. Thompson followed with an account of the work now being done on the low-grade ores of the Rossland district, including the application of the Elmore [illegible] concentration process.

At the evening session Mr. Thompson gave an account of the method adopted by him in building bulkheads in the Nickel Plate mine at Rossland to hold back water in an adjoining mine, having a head of 450 feet. They were built of brick and cement, and proved equal to the work. R. W. Brock read a paper on the "Lardeau District, B.C.," which was illustrated by maps and photographs. The district [illegible] from the head of Kootenay lake to Arrow lake, and contains three zones of mineralization. Between Poplar lake and Silver Cap mountain had not been prospected, but the rich strikes of free gold at Poplar Creek were very remarkable. The Lucky Jack claim had been staked three years ago and thrown up by Buckle, the original prospector. The railway ran past it for a year before the rich discovery of free gold was made.

B. A. C. Craig described the new concentration mill of the Canadian Corundum Co. Dr. W. A. Parks spoke on the value of stratigraphical geology, which, he claimed was being neglected for petrography. The importance of this branch of study was shown. Mr. Coste, the greatest economic stratigraphist in the country, had discovered the two oil fields on which the Canadian manufacture of oil depended. Stratigraphical research might develop other native resources. S. Dillon Mills read a paper on "Recent Rock Movements in the Laurentian."

Thursday morning was devoted to the reading of students' papers. The following were read and discussed: "Relative Attraction of Different Minerals for Residuum Oil," J. F. Hamilton, School of Practical Science, Toronto; "Limitations of the Cyanide Process," T. H. Plunkett, School of Practical Science, Toronto; "The Treatment of the Dry Ores of the Slocan District," T. W. Cavers, School of Mining, Kingston, Ont.; "Notes on Some Deposits in the Eastern Ontario Gold Belt," C. W. Knight, School of Mining, Kingston, Ont. These papers generally showed careful work.

The afternoon session was adjourned as a mark of respect to the memory of B. T. A. Bell.

In the evening J. Obalski read a paper on "Minerals Containing Radium Found in Quebec. These included a specimen obtained from a pegmatite dike at the mica mine near Lake Pied des Monts, about eighteen miles from Murray Bay, in the county of Charlevoix, Quebec, part of which showed 70.7 per cent. uranium oxide, and exercised a strong radioactive influence. Photographs taken by means of the radioactivity were shown. Another specimen was a substance resembling coal, also found in a pegmatic dike, the ashes of which contained a large percentage of uranium oxide, and showed a high degree of radioactivity. Dr. McLennan, Toronto University, said that it was interesting to learn that such ores had been discovered in Canada, and suggested that exploring parties be provided with testing apparatus. In reply to Prof. Miller, he said that so far the only economic use of radium was in medicine. Prof. Curie, being unable to obtain the ore from Austria, the great value of radium having caused an embargo to be put on the ore, was now looking elsewhere, and would be glad to buy such ores from Ontario or Quebec. Dr. McLennan suggested that the Government give a [illegible] discovery of specimens.

F. J. Fraleck, Belleville, referred to the [illegible] discoveries in Ontario, and Prof. Miller said that these deposits would be explored this summer by an electric [illegible], which hitherto has been obliged to import from India.

E. J. Davis, Commissioner [illegible] Ontario Crown Lands, in an address, said that he had [illegible] the suggestions [illegible] the mining engineers by abolishing royalties and leaving the mining laws unchanged. He regarded the presence of so many young men as a hopeful sign for the development of the country's mining interests, and referred appreciatively to the valuable services of Prof. Miller, Prof. Coleman and Thomas Gibson. Mr.

Davis, in closing, promised all possible assistance to the mining interests of the Province.

Professor Coleman read a paper prepared by A. B. Willmott, of Sault Ste. Marie, on "The Exploration of the Ontario Iron Ranges." Mr. Willmott referred to the geological similarity between certain belts in Ontario and those found south of Lake Superior. The lack of known ore bodies was owing to the fact that they had not been properly sought. He instanced the Josephine and Frances mines, where surface indications were slight, but where deep drilling had met with entire success. During the past two years systematic work had been done on the Steep Rock, Animikie, Michipicoten and Hutton ranges, and in most cases good ore bodies have been discovered. The work done in Ontario, however, was trifling compared with that going on on the American side of Lake Superior. The time had gone by when ore bodies were found by running through the woods with a canoe and a pick. Iron ranges had been found, and the question of their value could only be determined by careful and intelligent work.

F. T. Snyder read a paper on "Magnetic Separation." In the discussion which followed, it developed that Mr. Snyder was the inventor of a magnetic concentrator of a new type, with which very successful work had been done.

Friday morning was devoted to the reading of students' papers, which comprised "Mica," E. T. Corkill, Kingston; "Pioneer Iron Mine, Ely, Minnesota," E. J. Carlyle, McGill University; "Chlorination at North Brookfield, N.S.", H. Forbes, McGill University; "Notes on Mining in the Regent Group, Negaunee, Mich."' M. B. Atkinson, McGill University; "The Tyee Mine," Vancouver Island, B.C., D. C. Livingstone, McGill University.

In the afternoon a paper was read by W. G. Miller, Provincial Geologist, on "The Undeveloped Mineral Resources of Ontario." The presence of rare minerals had been determined in Laurentian formations, and with the advance of mining methods they would prove profitable fields for exploration. The wide area of gold-producing rocks discovered gave promise of vast undeveloped resources of this metal. A valuable silver mine was in operation at the head of Lake Superior, while silver had been discovered 500 miles east. The abundance of iron already in sight was an indication of the extent of undeveloped resources in this mineral. When facilities for transportation were provided, these would become paying properties. Good reasons existed for the belief that diamonds would be found in northern Ontario, the necessary geological conditions existing there. In discussing this paper Mr. Gibson referred to the success attained in briquetting Ontario peat.

A. C. Garde, of Sandon, B.C., called attention to the waste of zinc which had been going on, and reviewed some methods for overcoming it.

J. A. Dresser, Montreal, described an area of copper-bearing rocks in the Eastern Townships of Quebec, between Lake Megantic and the Arnold river, near the Maine boundary. These he believed to be a continuation of the New Hampshire copper ranges. The building of the Grand Trunk Pacific would open up this region and permit these deposits to be developed. A number of papers were read by title.

The concluding session was held on Friday evening. T. W. Gibson gave a statistical paper showing the progress of mining and the manufacture of its products during the past year in Ontario. The total output for 1903 was about 4.5 per cent. less than for 1902, but the special causes, such as the Sault situation, leading to this reduction, when carefully considered, showed that progress had been most satisfactory. He referred especially to the remarkable growth of the cement industry in Ontario, and to the possible over-passing of the demand by construction.

A discussion followed, in which reference was made to the uses of cement in buildings, in culverts and bridges, in foundations, in lining mine shafts, etc, including the use of reinforced concrete, or concrete and steel construction.

Professor L. T. Walker, of Toronto University, spoke briefly on "The Geological Survey of Canada as an Educational Influence," after which the Institute unanimously adopted a resolution presented by Mr. Craig: "That the president (Eugene Coste), Major Leckie, Treasurer Brown, Dr. F. Adams, Prof. R. W. Brock, Prof. T. L. Walker and B. A. C. Craig be a committee to confer with the Minister of the Interior and the heads of the provincial mining bureaus on the necessity of giving preference to geological students when making up geological survey parties; that the committee also point out the necessity of the Minister of the Interior and the Provincial Government taking steps to maintain the efficiency and increase the size of the permanent geological staff."

Mr. Coste read a paper on "Some Suggested Improvements in the Mining Laws in Canada," in which he advocated the passage of a Dominion mining act, to take the place of the present clumsy system of regulation by order-in-council. He pointed out that in some sections owners of placer mines were compelled to perform assessment work to the amount of $40 per acre each year, while quartz mine-owners only had to do work to the extent of $2 per acre for five years. He favored the imposition of assessment work to the amount of $5 per acre on all mining lands, with immediate forfeiture to the Crown in case of non-compliance. He pointed out that only about one-half of one per cent. of the mining lands granted in Ontario in the last six years were being worked. This meant that the chances of finding paying properties were reduced to one in several thousands. He characterized inactive claim owners as drones, who prevented others from taking advantage of the country's resources. He suggested a law to provide for some return to the people for a grant, either by doing work on their claims or by the payment of a yearly tax, if no work was done. The principle was that the grantee should make some return, either in development or money. With regard to the Dominion, he thought that the great interests of the Yukon and other territories—such as Alberta, Assiniboia and Saskatchewan—should be governed by a known and definite law, and ought not to be left to the discretionary regulation of orders-in-council, which are liable to be changed at any time.

Many members took part in the discussion, including Messrs. Thompson, Hardman, Gibson, Leckie, Blum, Miller, McCharles, Coste, Craig, Hobart and others. Unfortunately, some of the speakers seemed to have missed Mr. Coste's main point, that the law should prevent the locking up of mineral lands by parties who only wished to hold them for a possible rise in value, or, perhaps, to prevent others from working them.

This closed a successful meeting, notwithstanding the depression caused by the regrettable and untimely death of Secretary Bell.

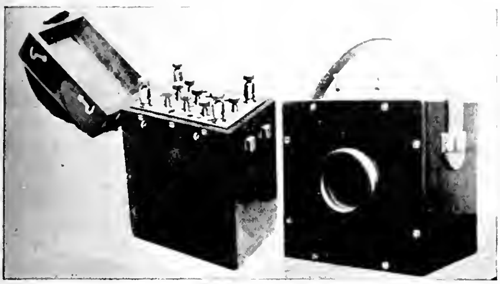
The following officers were elected for the ensuing term: President, Eugene Coste, Toronto; vice-president, E. B. Kirby, Rossland; treasurer, J. Stevenson Brown, Montreal. Council —J. McEvoy, Fernie; W. F. Robertson, Victoria; A. W. B. Hodges, Granby; W. G. Miller, Toronto; Major R. G. Leckie, Sudbury; John Blue, Eustis; Frank D. Adams, Montreal; Graham Fraser, North Sydney. As the by-laws require nominations to be made three weeks before the convention, no nomination could be substituted for that of the late B. T. A. Bell as secretary. The council will name an acting secretary, who will fulfil the duties of the office until the next convention.

PORTABLE VOLTAGE AND SERIES TRANSFORMERS.

The ordinary equipment for making electrical measurements affords chances for error which care cannot always overcome. It is frequently impossible to have at command instruments of all the capacities required to give the best results. Readings should be taken well within the range of the instruments, upon the portion of the scale where the divisions are large and open and errors in observation not likely to occur, but when, owing to lack of instruments of the proper capacities, readings are taken at the ends of the scale where the divisions are narrow, the greatest care cannot always prevent errors, or uncertainty as to the correctness of the readings taken. Even when instruments of all the desired ranges are at hand, it is still often difficult to obtain absolute accuracy and uniformity of results, owing to the variations in the different instruments, which make it impossible to check up the results obtained. In checking and testing electrical instruments with the use of the ordinary ap-

pliances, the standards often present the same difficulties and make it impossible to certify absolutely to the accuracy of the results obtained. In fact, the greater number of the errors and discrepancies in tests can be traced directly to lack of legibility of standards and to variations in the different instruments.

Manifestly, the ideal instrument either for taking measurements or for making comparisons with other measuring devices is one which will combine a great degree of legibility with a capacity for all ranges in which readings are to be taken, and any means by which these characteristics can be imparted to the instruments now in service is of practical value. The best method for accomplishing the desired result is by the use of transformers which will adapt the voltage or current to be measured to the capacity of the instrument to be used, adopting a ratio which will permit readings to be taken from the most legible portions of the scale. By this means any difficulty in readings is obviated, uniform accuracy at all capacities is assured, and a single voltmeter, ammeter and wattmeter will fulfil all the requirements of the most exacting service.

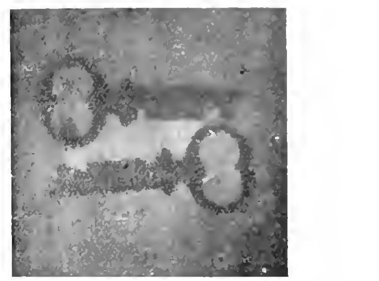


The portable series and voltage transformers made by Westinghouse Electric and Manufacturing Company, the former of which is shown in the accompanying illustrations, are especially designed for this work. Ample insulation and generous amount of iron and copper reduce to a minimum the error of transformation. They are designed to give accurate ratios at the load which will normally be imposed on the secondary, by the ordinary type of portable instruments, the output of the voltage transformer being about .15 amperes and the maximum voltage across the secondary of the series transformer being about three volts. The series transformer is made in two types. In one, designed for primary currents up to 100 amperes, the ratio is changed by plugs, somewhat as in the Wheatstone bridge. In the other type, which is designed for larger capacities, there is a circular opening through the transformer, and the conductor is passed through this opening, forming the primary. In this type, the ratio is changed by the number of turns made by the conductor passing it through the aperture once giving a ratio of 400 to 5, twice a ratio of 200 to 5, and four times a ratio of 100 to 5. The voltage transformers are furnished in various capacities up to 750 volts primary, the standard secondary voltage at the maximum primary voltage being 150 volts. The terminals on the primary are arranged so that a number of primary voltages may be obtained although they are not usually required in a great range of capacities as is the case with series transformers. These transformers are mounted in finely finished mahogany cases with carrying handles. The terminals of the voltage transformers and the plug contacts of the series transformers are protected by a cover, which, for convenience in use, is made removable.

RADIUM-BEARING MINERAL IN QUEBEC.

In last issue mention was made of the interesting discovery by J. Obalski, Inspector of Mines, Quebec, of a radium-bearing mineral in an abandoned white mica mine back of Murray Bay. Mr. Obalski showed a specimen of the mineral at the meeting of the Canadian Mining Institute last month, and gave the following account of his discovery:

Since the new element, "Radium," has been discovered attention has been called to the minerals containing it, and so far it appears that the Uranium ores are the only ones in which it has been found. In our Laurentian formation the Uranite, composed of oxide of Uranium and other rare metals, has been met with in the pegmatite dykes which have been operated as producers of white mica; and we had only the record of the Villeneuve mine, in Ottawa county, with Monazite and Uranite, and the Maisonneuve mine, in the county of Berthier, with Samarskite, although we have several other white mica mines and prospects in the Saguenay district. About ten years ago I found in a white mica mine, then operated by the Canadian Mica Co., a remarkable specimen, which I identified as "Cloveite." This specimen has a specific gravity of 8.43, and weighs 375 grams, or about 12 ounces; it is well crystallized in dodecaedron form, being derived from the isometric system. A complete analysis has not yet been made, but it contains 70.71 per cent. of uranium. Radium having been discovered and found to exist mostly in connection with Uranium ore, I experimented with the above mentioned crystal, and found it affecting strongly the photo plates, as shown by the accompanying radiographies. It had also a well-marked action on the electroscope. I came then to the conclusion that it contained Radium, and, to have my opinion confirmed, I showed the specimen to Professor Rutherford, of McGill University, who, after testing it, stated that its radio-activity was equal to four or five the one of the crystal if it had been entirely composed of Uranium, and that it contained one-tenth of a milligram of Radium, making it comparable with the best pitchblende so far operated for Radium.



A Radiograph, the Result of Nine Hours' Exposure Through a Piece of Wood.

This crystal may be an accidental one, although I have found other small pieces of the same mineral in this vein, but

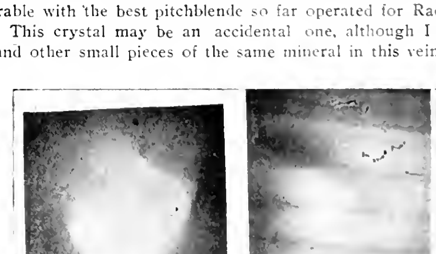


Fig. 1—Photo taken from Rays from the Crystal.
Fig. 2—Radiograph taken through Wood, showing Grain of Wood.

I have also found a carbonaceous material, burning quite easily, and leaving a large proportion of ashes, containing oxide of Uranium. I am not able to state what is the relation between the two specimens, but I think this fact important, and I propose to make a further investigation next summer. The white mica vein where those specimens came from is situated near the Lake "Pieds des Monts," about eighteen miles back of Murray Bay, in the county of Charlevoix, on the north shore of the St. Lawrence.

Specimens of the coal referred to have been tested by M. L. Hersey, of Montreal, with the following results: "This sample of coal has a fibrous, irregular structure, and contains

a small amount of mica; it proved to be a non-coking, bituminous coal, yielding considerable gas, which burned with a bright yellow flame.

Volatile matter (including volatile combustible matter and a small quantity of moisture)	40.185%
Fixed carbon	52. 59%
Ash	7.225%

Crystal of Uranium Ore—Actual Size.

"The ash itself was analyzed, and found to contain 2.56 per cent. of Uranium, based on the coal, which is equal to 35.43 per cent. of Uranium in the ash itself. It is important to note that the color of the ash was olive green, being due to the presence of oxide of Uranium. In another test the coal was not burnt, but was merely finely pulverized, and the powdered coal treated with boiling nitric acid to dissolve the Uranium compounds. It is then interesting to note that the Uranium may be extracted by the direct treatment of the coal with nitric acid."

LIGHT, HEAT, POWER, ETC.

Dundas, Ont., is discussing the question of acquiring the gas works.

The I.C.R. is erecting electric plants at Mulgrave and Point Tupper.

Sudbury, Ont., will have electric power in June. It will bring 3,000 h.p. from the Vermilion river, eleven miles distant.

The citizens of Kingston, Ont., on March 21st passed the by-law authorizing the city to take over on April 1st the light, heat and power company at the arbitration award of $170,373.

Owing to the defective lighting at Stratford, Ont., the city council will employ an expert to examine the gas and electric lighting plants. Cancellation of the company's franchise is talked of.

A branch company of the Victoria Manufacturing Co., Auburn, Me., has been formed comprising: J. H. Whitman, Port Dufferin, N.S.; Mr. Howland, Boston, Mass.; and C. W. Waldron, Auburn, Me., to establish a factory for making acetylene gas generators at St. John, N.B.

The by-law to purchase the plants of the Gas and Electric Light Co., Sherbrooke, Que., for $233.000 has been defeated by reason of the fact that the aggregate value of property owned by the minority who voted against the purchase was greater than the majority who favored it.

The Stayner Electric Light and Power Co. has been incorporated to develop the water power on the Nottawasaga river, five miles from the town, to transmit light and power to Stayner and other municipalities. The provincial directors are: Messrs. Jos. Knox, M. Gartlan, S. L. Deylin, W. A. Doner and D. G. Bell.

The Collingwood Light, Heat and Power Co., Ltd., Collingwood, Ont., has been incorporated, with $200,000 capital, to operate the gas lighting franchise granted to E. D. Morris last year. The contracts have been let for a carboretted water gas plant, to be in operation by October 1st. The provisional directors are: W. G. Parsons, W. Postlethwaite and A. D. Crooks, of Toronto.

The Brome Lake Electric and Power Co., Waterloo, Que., contemplate installing an auxiliary steam plant to provide against a shortage of water power.

The first annual report of the Trinidad Electric Company, the third electric plant built by Canadians in the West Indies, just issued, shows gross earnings, $176,631; operating expenses, $75,446; bond interest (on $720,000), $36,000, leaving net earnings, $65,186. A quarterly dividend at 5 per cent. per annum on the capital ($1,032,000) was paid in January, leaving $55.921 surplus. As construction is not yet completed, this showing is most satisfactory.

On its transmission line from Niagara Falls to Toronto the Electrical Development Co. will use steel towers, 8 or 10 feet square at the base and from 40 to 45 feet high, instead of poles, between Niagara Falls and Toronto. They will be 400 feet apart. The company will commence with four transmission lines of a normal capacity of 40,000 horse-power in all, and an overload capacity of 50,000 horse-power.

Professor R. B. Owens, lecturing before the Insurance Institute of Montreal recently on "Interior Electric Wiring," stated there were three primary considerations to be observed: First, the conductor must be of ample current carrying capacity in order to avoid overheating with consequent danger of fire; second, it must be so insulated as to render it harmless and prevent leakage; third, the best current regulating and pressure limiting devices should be installed. The speaker stated that interior electric wiring had, as far as he could judge, been as much neglected as any other thing of like interest. He knew a few buildings and places in Montreal that were properly wired, but he thought that he could count them on the fingers of both hands.

PLUMB BOBS.

F. W. Salmon, C.E., Burlington, Iowa, gives readers of the Canadian Engineer a useful caution about the material in plumb bobs. He says: They may be made of cast brass or bronze or of bar brass, but should not in any case be made of cast iron because at the present time electricity is so common that a cast iron plumb bob is often drawn out of its proper position by some local electrical attraction. For this reason the steel points are made comparatively small. The small cap that screws into the head of the plumb bob and receives the string or line should be knurled on the edges so as to be readily screwed in or out.

—A great amount of attention is being given to the question of rapid change gear appliances on lathes, both by lathe builders and by lathe users,, and an ever-increasing preference is being shown for such lathes over less modern types. It will, therefore, be of much interest to the machine tool trade to learn that the American Tool Works Company, of Cincinnati, have, through purchase, acquired manufacturing rights under the several patents which have been issued pertaining to such devices. This gives them the undisputed right to build without restriction their improved new "American" engine lathe with quick-changing mechanism for thread cutting and feeding. This lathe has previously been shown in these columns, and its merits are recognized by progressive shop managers. The line of sizes in which this lathe is built ranges from 14-in. to 36-in., inclusive, and full information on any size will be furnished by the makers.

THE METRIC SYSTEM.

Sir,—Mr. Halsey has invited me to reply to a letter of his on this subject which appeared in your issue for this month. I very gladly do this, though, as a matter of fact, I think that your leader on the question, which appeared in the same number, left very little more to be said. The statement which I made previously as to the survival of old weights and measures, and old names for new weights and measures, was based upon information which reached me from correspondents in different parts of Europe, and I have every reason to believe their testimony to be trustworthy.

It is not to be supposed that it would be impossible to find, even now in France and Germany, in villages remote from railway communication isolated cases of persistence in using old units, or old names for new units. I will go further, and say that after the metric weights and measures have been introduced into this country it may be many years before the old names will die out altogether in the mountains of Wales and the Highlands of Scotland. But what has that to do with the question? It will be found that wherever the inspectors of weights and measures can reasonably reach the users the new weights and measures will soon be adopted; and what does it really matter if some of the old women, who keep village shops, and only have a few transactions a week, fail to fall into line as quickly as do the residents in busy centres?

I maintain that, with such exceptions as above alluded to, there is no continuance of the old names or units in France or Germany, and I have excellent authority for this contention. Most decidedly do we claim a country as a metric using one wherever a law has been passed for the adoption of that system. For the purposes of our trade with such a country it does not matter whether the system has penetrated entirely through the interior of that country. If it be used in the customs house, we have to send invoices based on the metric scale.

We shall very soon now be able to claim that the metric system is used throughout the whole of the British Empire. Our bill has been read twice in the Lords, and has every prospect of passing both Houses with but slight modification. We have already presented a large number of extensively signed petitions in support of the measure, and are about to present a further batch. The attitude of the British colonies has been very clearly shown to be entirely on our side by a Government paper published about ten days since, of which the following is an abstract:

"The metric system is already used in Mauritius and Seychelles. The following are favorable to its adoption: Australia, New Zealand, Cape of Good Hope, Transvaal, Orange River Colony, Southern Rhodesia, Gambia, Northern Nigeria, Gibraltar, British Guiana, Trinidad, Leeward Islands, Windward Islands. Also, with a reservation that it must be adopted in the United Kingdom or in the Empire generally, Sierra Leone, Southern Nigeria, Ceylon, and Falklands. Hong Kong would take common action with other colonies. The States of New South Wales, Victoria, and Western Australia are also favorable, but together with South Australia and Tasmania, consider that the matter is one for the Commonwealth Government. Fiji is doubtful, but must follow Australia and New Zealand. British New Guiana would go with Australia. Jamaica and British Honduras need the adoption of the system in the United States of America. The practice of India is important to the Straits Settlements, who would be followed by Labuan; and the Bechuanaland Protectorate would follow the rest of South Africa. St. Helena, Cyprus, Lagos, Wei-Hai-Wei, Barbados, and Bahamas are on the whole unfavorable. The Gold Coast Colony and the State of Queensland are prepared to adopt, but consider that inconvenience would occur. Natal cannot consider the matter until some general lines of legislation have been agreed upon by His Majesty's Government. No definite answer has been given by Newfoundland, Malta, or Bermuda. Canada has not yet replied."

I will admit that Mr. Halsey should know better than I do what are the prospects of the Metric Bill at Washington, but I am convinced that it will give a great advantage in competing for foreign trade if we should have a few years' start of the States in the use of the metric system, and so I do not trouble very much about this particular prophecy of his.

I am, Sir, your obedient Servant,

E. JOHNSON,

Secretary Decimal Ass'n, London, Eng.

* * *

Capt. J. W. Pierce, the steamboat designer, of Portsmouth, near Kingston, who designed some of the fastest steamers and yachts on the St. Lawrence, died last month, at the age of 84.

MINING MATTERS.

Armand M[illegible] Smelting Co., state that [illegible] will be [illegible] year. Much machinery [illegible] at Matane, Q[illegible] the ores concentrated on the spot.

C. O. Macdonald is visiting Europe in the interests of the North Atlantic collieries, Port Morien, N.S., to study the principal British sub-marine collieries and the economical methods adopted in foreign countries.

Anderson Bros., of Woodstock, Ont., will establish a furniture factory in Newcastle, N.B., costing $25,000, and employing 75 men. The town will lend $20,000, without interest, repayable in twenty yearly instalments, and will give free water and exemption from taxation beyond $5,000.

The Eastern Townships Mining and Smelting Co. proposes to establish a copper smelter in Sherbrooke, Que. The capital is $40,000, and the company agree to put in a plant costing $25,000 within fifteen months. They ask the city for a bonus of $10,000, and exemption from taxation for ten years.

J. H. Plummer, president of the Dominion Iron and Steel Co., states that, when completed, the company's plant will have a capacity of from 200,000 to 250,000 tons of steel per year, and he believes they could turn out all the pig iron Canada could consume. The capacity of the washing plant is 200 tons per hour, and all coke will be produced from washed coal, thereby freeing it from sulphur and other impurities. 2,000 men are now employed.

* * *

INDUSTRIAL NOTES.

C. Karsh, of Aylmer, Ont., has started a spring mattress factory at Dundas, Ont.

The Maritime Engineering Co., St. John, N.B., has taken over the business of J. Weir & Son.

Representatives of the Henderson Roller Bearing Co. visited Brantford, Ont., recently, with a view to locating there.

A company with W. St. Clair at the head will establish in the old building of the Blatchford Organ Co., Galt, Ont., a factory for the manufacture of cement and mining machinery.

F. L. Smidth & Co., now located at 80 William St. and 66 Maiden Lane, New York, N.Y., will move to the J. Monroe-Taylor Building, 30-41 Cortlandt St., New York, on or before May 1st, where they will have a more desirable location and larger and better lighted offices.

A. J. Stevens, C.E., 499 Ontario St., Toronto, has been appointed Canadian representative of the Trussed Concrete Steel Co., of Detroit. The company proposes to have the shearing of the bars used in their structural work done in Canada, and Mr. Stevens will be glad to receive offers from firms who have a "bull dozer" or heavy power shears.

The new elevator at Collingwood, Ont., will be built of steel and concrete, and will have a capacity of 1,000,000 bushels. It will have 18 circular bins, 30 feet in diameter, 90 feet high, with a steel cupola 65 feet high, containing two 1,500-bushel scales and garners. The new marine leg will be 72 feet from that of the present elevator and their combined capacity will exceed 25,000 bushels per hour. The estimated cost, including the buildings, tracks, and a new dock, is $250,000.

The Colburn Machine Tool Co., of Franklin, Pa., has arranged with the Ludwig-Loewe Co., a large machinery firm having warehouses in London and Berlin and other continental centres, to represent them in Europe. H. W. Brickenridge, of this company, paid a short visit last month to leading cities of Ontario and Quebec, and reports that the boring mills, which are the sole specialty of his company, are meeting with an active demand in foreign countries, as well as in America.

LITERARY NOTES.

"Facts about Peat." By T. H. Leavitt. $1. Lee & Shepard, publishers, Boston, Mass.

The author built peat works years ago at Lexington, Mass., and wrote a treatise on the subject, of which the present book of 115 pages is a revised edition. He tells what peat is, where it is found, and describes some of the processes of manufacture, including his own. In this connection he refers to the experiments made in Canada, and speaks highly of the methods adopted by A. Dobson at Beaverton, as described in The Canadian Engineer of February last, in which article, by the way, an injustice was done the author in stating that his work had been abandoned. He calls attention to the enormous deposits of peat in Canada and the States, and looks forward to the time when it will be one of the chief fuels for steam and domestic purposes. The other uses of peat, such as a material for paper, for textiles, for fertilizing and as an antiseptic and disinfectant are also touched upon.

"The Metric Fallacy." By Frederick A. Halsey and Samuel S. Dale. 200 pp.; 8vo., cloth; illustrated; $1. Published by D. Van Nostrand Co., New York.

The authors oppose the introduction of the metric system of weights and measures in the United States, and claim that its adoption would necessitate the abandonment of present mechanical standards. They point to the persistence of old units in metric countries, such as France, Germany, Spain, Turkey, etc., as evidence of the failure to make the system effective in the countries which have adopted it officially.

"Steam Carriages and Traction Engines." By Wm. Fletcher, M. Inst., Mech. E. Illustrated; 428 pp.; 8vo.; 15s. net. Published by Longmans, Green & Co.. 39 Paternoster Row, London, Eng.

Mr. Fletcher, who is the author of two previous works on traction engines and steam locomotives on common roads, and of two treatises on the steam jacket, gives in this volume an account, historical and mechanical, of the various types of steam carriages and traction engines in use in Great Britain and the United States. The mechanical features of most of these are dealt with and explained in 250 illustrations, and the future of steam road carriages and load-hauling by steam is indicated as very promising. It is the most comprehensive work on the subject that has come to our notice.

"Reinforced Concrete Construction." By L. J. Mensch, C.E. 217 pp.; illustrated; $2. Published by the Cement and Engineering News, Chicago.

The object of this work is to give in simple language the applications of reinforced concrete to structural work. By means of diagrams, half-tone illustrations and tables, much information is given on the possibilities of economical construction by this method of combining steel and iron with concrete. As the subject is not well understood by many engineers, architects and contractors, because of the fragmentary character of literature dealing with it, the present work will be very helpful. It gives examples of steel concrete applied to bridges, culverts, sewers, dams, docks, factory and other buildings, tanks, girders, columns, etc.

"Oil Engines." By W. A. Tookey. 138 pp.; illustrated; one shilling, net. Published by Merritt & Hatcher, Limited, Grocers' Hall Court, London, E.C., Eng.

A compact and convenient hand book on the construction and operation of oil engines with hints on how to purchase, erect and run them, with notes on the character of oils used. A short description is given of the principal types of oil engines in use in Great Britain. The author is also the compiler of a useful hand book on gas engines issued at the same price and by the same publishers.

Other publications received are:

Report of speeches in the House of Lords on the bill for the introduction of the Metric System, with copy of petition in support of the measure. Published by the Decimal Association, Botolph House, Eastcheap, London.

A pamphlet on the Metric System at 25 cents, published by Gottman & Leroy, 2265 St. Catherine St., Montreal.

L'Electricité dans les Mines en Europe. By Emile Guarini. Price 5 francs. Published by Ramlot Freres et Sœurs, Rue Gretry, Brussels, Belgium. A pamphlet of 46 pages with illustrations on the applications of electricity to mining in Great Britain and European countries. Also by the same author at one franc "L'Electricité en Agriculture."

Index to the Technical Press, giving the titles, and an indication of the contents of articles in the engineering press of the world. Published monthly at 10s. 6d. per year, at 11 Queen Victoria St., London, Eng.

Report of address, "Build up Canada," by Sir Sandford Fleming before the Canadian Club, Toronto. 15 pp. and map. A plea for the construction of a new transcontinental railway opening up the more northerly territory of Canada.

American Railway and Maintenance of Way Association, 1562 Monadnock Block, Chicago. Bulletin No. 48, reports of committee on wooden bridges and trestles, on ties, on roadway, and on yards and terminals, with recommendations and discussions; also Bulletin 49 on reduction of gradients and elimination of curvature on Union Pacific Railway, by J. B. Berry, chief engineer.

Year Book of the American Society of Mechanical Engineers for 1904, containing constitution, by-laws and list of members. F. R. Hutton, secretary, No. 12 West 31st St., New York. Next convention in Chicago, May 31st to June 3rd.

"Gold Deposits of New Zealand." By Alexander McKay, F.G.S., Government Geologist. An estimation of the relative quantities of reef and allevial gold, reprinted from New Zealand Mines Record and published at Wellington, N.Z., by the Colonial Government.

In a pamphlet of 74 pages, Charles Baillairge, C.E., Quebec gives a very instructive summary of the various papers, pamphlets, and articles he has written on engineering and cognate subjects since 1866. There are over one hundred entries, and the summary here given is a measure of Mr. Baillairge's tireless energy, no less than a revelation of his intelligent study of a wide range of topics not always limited to the work of the engineer. Price 50 cents per copy.

The publishers of "Knowledge," 326 High Holborn, London, issue a diary and handbook which is very valuable for amateur astronomers and students in science. The edition for 1904 contains, besides a monthly astronomical ephemeris, and charts of the paths of the planets for the year, twelve star maps showing the night sky of each month of the year, many miscellaneous notes and tables, and the chief celestial phenomena of the year. There are special articles on the camera, as applied to science in the region of astronomy, microscopy and natural history; on the uses of microscopes and telescopes; on practical meteorology and other subjects. There are 340 pages, 6 by 9-in., ruled for the users' notes, with index and special headings. Price 3s., net. The publishers of "Knowledge" have added a second title to their excellent monthly which is now called "Knowledge and Illustrated Scientific News," expressive of the more general scope which the paper now takes, while still maintaining its special fields of astronomy, natural history, botany, etc.

The Marine Review, of Cleveland, issued last month is an elaborate "fitting out" number. Besides the news of the spring movements, it was devoted to a discussion of the shipping question in all its various phases. The list of contributors embraced the Hon. Geo. B. Cortelyou, secretary of the Department of Commerce and Labor; Senator Wm. P. Frye, of the United States Senate; John McNeil, president of the Brotherhood of Boilermakers and Iron Ship Builders of America, and Winthrop L. Martin, author of "The History of the American Merchant Marine," and many others. Detailed drawings are published of a new dipper dredge for the Canadian Government. The number is splendidly illustrated throughout with more than ninety beautiful photographs.

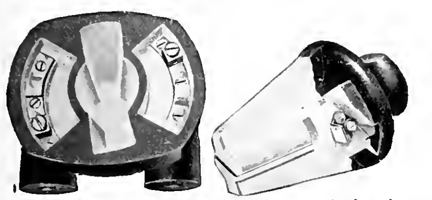
The Robb Engineering Company has received an order from J. G. White & Co., of London, England, for a 300-h.p. Robb-Armstrong tandem compound engine to be a duplicate of two engines supplied by them for the Perth Tramways, Western Australia, five years ago.

TRANSFORMER PRIMARY CUT-OUT.

An improved form of a transformer primary cut-out, designed to protect the high tension side of transformers, is being introduced by the Westinghouse Electric and Manufacturing Company. It is made entirely of porcelain, and its form is such that it has high insulating and arc-breaking qualities. The plug to which the fuse is attached projects between the terminals, the upper end of it rising well into the top of the block, and interposing an effective barrier, and thus

Transformer Primary Cut-out.—Showing insulator top, holes for screws and openings for viewing fuse.

making it impossible to maintain an arc. The fuse is eleven inches in length, making a long break, and is so placed that the vapors of a discharge are blown down and out of the device and away from the terminals. The line wire is carried directly to the top of the device and attached to it as to an ordinary insulator, which it thus displaces. To reach the terminal the wire must be bent around the edge of the block, and is so supported in an angle between the terminal post and the porcelain case that it cannot be loosened by any swaying of the wire in the wind. The plug enters from the bottom. When it is raised into place, a partial turn draws the knife



Transformer Primary Cut-out.—Showing terminals, plug with groove for fuse, and locking device.

blades on the plug into the jaws on the block, preventing the plug from dropping out or being blown out. All live parts are protected from the weather by the projecting edges of the block and by placing the terminals well above its lower surface, with no apertures in the side or top. A bend in the fuse wire brings it into plain view at all times, and it is thus possible to observe its condition without removing the plug, guarding against any liability of opening the circuit when there is a current upon the line. It is fastened to the cross-arm or other support by two screws, passing through porcelain tubes, which form a portion of the block. It has a rated capacity of 2,500 volts, 30 amperes. It is light and easy to re-fuse.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

At the February meeting of the Electrical Section of the above society, a paper was read by Dr. Winship, of the Gould Electric Storage Battery Company, of New York. It was a description of the construction and application of storage battery of the present day. Some discussion took place, and the question of battery deterioration and the effect of varying temperature upon the battery was gone into. At a meeting on 24th March, the subject of the use of electricity on canals was up for discussion, and papers were read by L. A. Herdt on "The [illegible] Canal," and by F. H. Leonard, Jr., on "Electr[illegible] for the Cornwall Canal."

At the last meeting of the Mining Section a paper was read by C. P. Campbell, on "Mine Timbering [illegible] of the Lake Superior Mining Co., Michigan."

At the meeting of the Mechanical Section on March [illegible], a paper was read by A. W. Robinson, on the hydraulic dredge "J. Israel Tarte."

On the evenings of March 3rd and 10th meetings of General Section were held for the continuation of the discussion of Mr. Jamieson's paper on "Grain Pressure in Deep Bins." Both meetings were well attended, and the discussion was carried up to a late hour. The following took part: Messrs. Vautelet, Kennedy, Toltz, Goldmark, Johnson, Sherwood, Lordly and Prof. Bovey.

J. J. Taylor's paper on the "Shubenacadie Bridge" was put down for 31st March.

A ballot for new members will be opened on the 14th April.

A meeting of the General Section will be held April 7th. Business talk on rock asphalt and mastic asphalt, and their use in the construction of bridges, reservoirs, etc., illustrated by lantern slides, by Mr. Wiederhold, visitor.

GRAIN PRESSURES IN DEEP BINS.*

By J. A. Jamieson, C.E., Mem. Can. Soc. C.E.

The comparatively recent changes in the materials of construction of grain storage bins or silos has made the question of grain pressure one of great importance at the present time. Until within a comparatively recent date practically all grain elevators on this continent were built of wood, the storage bins being of laminated or cribbed construction, formed by building a number of walls both longitudinally and transversely of the building. The walls were constructed of plank 2-in. thick, laid flat and spiked one to the other, and from 6 to 8-in. wide, according to the quality of the material used and the size of bin required. The width of plank or thickness of wall decreased towards the top, and the walls were spaced 12 to 14 feet apart in both directions, thus subdividing the storage space into deep bins 12 to 14 feet square and 60 to 70 feet deep.

So long as this construction and size of bin was maintained, there was no great urgency for knowing accurately the lateral pressures produced by grain, as the thickness or necessary strength of the walls to safely resist the lateral pressure, and the strength of the hopper bottoms of the bins to carry the vertical load, had been well established by practice.

With a wooden bin wall of sufficient strength to resist the lateral pressure, the wall had ample area as a column to carry the vertical grain load transmitted to it by friction. This form of bin construction has been in use practically from the inception of the grain elevator system on this continent, and in many respects is admirably adapted for the purpose. The defect from a structural point of view was its lack of vertical rigidity, by reason of the shrinkage of the wood and the compressing of the many horizontal joints during the first loading of the bins, which usually amounts to a settlement of 12 to 18 inches in 70 feet, thus necessitating very great care being taken to distribute the grain load when first filling the bins in order to prevent undue strain on the structure. When, however, the initial settlement has taken place, no further precautions are necessary. The chief defect, however, of the wooden elevator is its liability to destruction by fire, involving heavy loss on the building and contents, and therefore high insurance premiums.

The increasing cost of insurance and timber, combined with the great inconvenience and loss of business to transportation companies by the destruction of an important terminal elevator, created a sudden demand for fireproof buildings; and the consequent change in the materials of construction made it necessary that a more accurate knowledge

*From a paper read before the Canadian Society of Civil Engineers.

of grain pressures under all working conditions should be obtained to permit of the intelligent design of bins of different materials or increased diameter and depth. Notwithstanding that the modern elevator system had its inception, and has reached its highest development in America, there is no record of any systematic series of tests having been made on this continent, with a view of obtaining a definite knowledge of the pressures produced by grain in deep bins. In fact, there is ample evidence that some who have undertaken the design and construction of bins for the storage of grain, coal, or other granular substances have been entirely lacking in knowledge of this subject; and there have been very few of even those engineers making a specialty of grain elevator or coal bin construction who could calculate with any degree of confidence the pressures produced by granular materials in bins having a breadth and depth varying to any considerable extent from standard size or constructed of different materials.

The author does not, however, wish to convey the impression that all grain elevator designers have been entirely groping in the dark on this subject, nor does he claim to have had a superior knowledge of grain pressures over other experienced elevator engineers, before undertaking the extensive and systematic series of tests which form the chief subject of this paper.

It has been well understood by experienced grain elevator engineers that grain stored in bins of standard dimensions (12 to 14 ft. square and 60 to 70 ft. deep), produced comparatively small vertical and lateral pressures, and that much the greater part of the grain load in the bin is carried by the walls and only a small part on the bin bottom, and that this is due to the friction between the grain and the bin walls.

Very few, if any, have, however, realized to what extent this was governed by ratio of breadth to depth of bin, and the ratio of the horizontal area of the grain column to the bin walls; and therefore to what extent the vertical and lateral pressures are increased, due to increase of horizontal dimensions of the bin.

This lack of data by which to calculate the pressures and strength of grain storage bins of varying dimensions and materials of construction, has been greatly felt by experienced grain elevator designers who have fully realized the importance of an ample factor of safety combined with economy of construction. It has, therefore, been rather surprising to find that some designers instead of conducting a series of tests to obtain the pressures produced by grain, which would enable them to intelligently proceed with their designs for bins of any dimensions, have built experimental tanks or bins at large expense, from which they gain very little practical information, since some parts of the construction when loaded may be strained far beyond its safe strength, and the weaknesses only be developed by time, while other parts may be of unnecessary strength. This may be called the "fit and try process," on which the wooden grain bin was originally developed and which was no doubt necessary in ancient times, but should now give place to modern engineering methods.

With an accurate knowledge of the pressures produced by grain and the necessary experience to enable the data to be intelligently used, and with the present knowledge of the strength of different materials of construction, there is no reason why a grain elevator may not be designed and built with the same regard to safety and economy as any other engineering work. It must, however, be borne in mind that while engineers may keep up with the times, their clients do not always do so, and that a structure actually built and in use, even if it has many weaknesses of which he is not aware, will often be selected by the prospective owner in preference to the most carefully prepared designs based on accurate data.

Most of the experienced elevator designers, knowing the very heavy loads that have to be carried in grain elevators or storage structures, have hesitated to depart from the standard sizes of bins. Unfortunately the demand for cheap storage and low insurance rates, has brought men into the field without either engineering knowledge or grain elevator experience, who have undertaken the design and construction of storage tanks apparently built by pure guess work, or at best, on some indefinite percentage of water pressure, with the result that in most cases serious weaknesses have developed and in others total failure and serious losses have occurred. This has frequently been the fault of the prospective elevator owner to whom low first cost of construction is often the chief and sometimes apparently the only consideration.

(To be continued.)

—The Hamilton Tool and Optical Co., Hamilton, Ont., has been increasing its staff and putting in new special tools for fine punch and die work. Caliper gauges and graduated scales are among the new lines being made by this company.

—Among the papers read before the Engineers' Club of Toronto during the past month was one on "Military Engineering," by Prof. W. R. Lang, of Toronto University. An instructive topical discussion, led by E. R. Clarke, of the Canada Foundry Co., took place on pumping machinery.

—Experiments with Signor Perego's system of telephoning over telegraph wires have been carried out at Milan, Italy, over a distance of about two hundred and forty-five miles. In spite of the fact that four telegraph stations were working on the same line, messages were heard clearly at either end of the wire.

—Among the papers read before the Engineering Society of the School of Practical Science, Toronto, last month was one by Willis Chipman, C.E., on "Sewage Disposal," and one by A. G. Christie, of the Westinghouse Co., of Pittsburg, on the steam turbine. Mr. Christie's paper was read by Mr. Dunlop, of the Hamilton branch of the Westinghouse Co.

—We have received enquiries regarding the new motor reported in last issue to have been invented by a man named Thornley, of Burton-on-Trent, Eng. In these days of remarkable achievements one must keep an open mind as to new inventions, but we share our correspondent's skepticism as to the claims made for this motor until more definite information is forthcoming.

The George B. Meadows Wire, Iron and Brass Works Co., Toronto, have issued a booklet on baby's wire cots, which they justly think reflects credit on the printer's art in Canada. Those who read the booklet will also think the booklet reflects equal credit on the compiler, who is apparently a good father as well as a good writer.

John S. Fielding, M.E.,and C.E., has returned to Toronto to resume practice as consulting engineer at No. 20 King St. East. Mr. Fielding is well known in Ontario, having been prominent in the construction of bridges, piers, breakwaters, etc., and has had extensive experience in recent years with the Carnegie Steel Co., at Pittsburg, Pa., and also at Sydney, C.B., where he spent three and one-half years as one of the designing engineers of the steel plant there.

Hon. Charles A. Parsons, the inventor of the steam turbine bearing his name, has applied for an extension of time within which he must manufacture in this country to save his Canadian patent. In his application he states that a steam vessel fitted with turbine machinery of about 3,000-h.p. is being constructed on the Tyne in England to ply on Lake Ontario and other inland waters this coming summer. It has been found impracticable as yet to equip and start a factory in Canada for the manufacture of turbine machinery, which is practically a new art, but arrangements are on now with the view of manufacturing on a commercial scale in this country.

MINERAL PRODUCTION OF CANADA LAST YEAR.

The following is a summary of the mineral production of Canada prepared by Elfric Drew Ingall, M.E., Mining Engineer to the Geological Survey of Canada, assisted by J. McLeish, B.A., of the same department. These figures are subject to revision.

Product.	Quantity. (a)	Value. (a)
†Metallic.		
Copper, pounds	43,281,158	$ 5,728,261
Gold, Yukon, $12,250,000 } Gold, all other, $6,584,490 }		18,834,490
Iron ore (exports), tons	368,233	922,571
*Pig iron from Canadian ore	42,052	707,838
Lead (c), pounds	18,000,000	762,660
Nickel (d), pounds	12,505,510	5,002,204
Silver (e), ounces	3,182,000	1,700,779
Zinc (i), pounds	900,000	48,600
Total metallic		33,707,403
Non-Metallic.		
Actinolite, tons	550	3,108
Arsenic, tons	257	15,420
Asbestos, tons	31,780	891,033
Asbestic, tons	10,548	13,819
Chromite, tons	3,383	33,830
Coal, tons	7,996,634	15,957,946
Coke (f), tons	544,132	1,663,725
Corundum, tons	No returns.	
Felspar, tons	13,228	18,066
Fire clay, tons	2,317	2,505
Graphite, tons	738	23,745
Grindstones, tons	5,538	48,302
Gypsum, tons	307,489	384,259
Limestone for flux, tons	277,452	259,244
Manganese ore (exports), tons	135	1,889
Mica, tons		159,473
Mineral pigments—		
Baryta, tons	1,163	3,931
Ochres, tons	6,226	32,440
Mineral water		100,000
Moulding sand, tons	3,568	7,256
Natural gas (g)		168,900
Peat, tons	1,100	3,300
Petroleum (h), barrels	461,336	922,672
Phosphate, tons	1,329	8,214
Pyrites, tons	33,530	126,133
Salt, tons	53,537	334,088
Talc, tons	688	2,064
Tripolite, tons	835	16,700

Structural Materials and Clay Products.

Cement, natural rock, 92,252 barrels	75,655
Cement, Portland, 627,741 barrels	1,090,842
Granite	150,000
Pottery	200,000
Sands and gravels (exports), 355,792 tons	124,006
Sewer pipe	317,970
Slate	22,040
Terra-cotta, pressed brick, etc	386,532
Building material, including bricks, building stone, lime, tiles, etc	5,650,000
Total structural materials and clay products	8,017,045
Total all other non-metallic	21,202,062
Total non-metallic	29,219,107
Total metallic	33,707,403
Estimated value of mineral products not returned	300,000
Total, 1903	$63,226,510
1902, Total	$63,885,000
1901 "	66,339,158
1900 "	64,618,268
1899 "	49,584,027
1898 "	[illegible]
1897 "	[illegible]
1896 "	[illegible]
1895 "	[illegible]
1894 "	[illegible]
1893 "	[illegible]
1892 "	[illegible]
1891 "	[illegible]
1890 "	[illegible]
1889 "	[illegible]
1888 "	12,518,894
1887 "	[illegible]
1886 "	[illegible]

†It is to be borne in mind that the only general and definite standard for valuing the varying and various products of the metal mining industries of the country is that herein adopted, viz., the final value of their metallic contents at the average market price for the year.

This reduces them to a common datum line for the purposes of this general table and results in such uniformity of presentment that the figures are reasonably comparable from year to year in illustration of the fluctuations and the growth of different industries.

The non-metallic minerals having a tangible use—value as individual minerals are put down at the average spot value for each.

Whilst this plan of course results in some discrepancies it is adopted as the best attainable method for the purposes of this general statement which is practically an advance presentation of the mineral industry as a whole.

The detailed presentation of the particulars of the various subordinate industries from other standpoints is reserved for the annual report of the Mines Section.

* The total production of pig iron in Canada in 1903, from Canadian and imported ores amounted to 297,885 tons, valued at $3,742,710, of which it is estimated 42,052 tons valued at $707,838, should be attributed to Canadian ore and 255,833 tons, valued at $3,034,872 to the ore imported.

(a) Quantity or value of product marketed. The ton used is that of 2,000 lbs.

(b) Copper contents of ore, matte, etc., at 13.235 cents per lb.

(c) Lead contents of ores, etc., at 4.237 cents per lb.

(d) Nickel contents of ore, matte, etc., at 40 cents per lb.

(e) Silver contents of ore at 53.45 cents per oz.

(f) Oven coke, all the production of Nova Scotia and British Columbia.

(g) Gross returns for sale of gas.

(h) Includes crude oil sold to refiners and oil sold for fuel and other purposes.

(i) Zinc contents of ores at 5.400 cents per lb.

REMARKS.

The main feature presented by the mineral industry of Canada, as a whole, consists in the decrease in the grand total of production of a little over one per cent. in comparison with the figures for 1902. A comparison of the items for the two years shows the reason for this falling off. The shrinkage in the production of the Yukon placer gold fields accounts for $2,250,000 of the total diminishment of over $2,500,000 in the gold output of the country. This is augmented by over $1,000,000 decrease in the values of the output credited to others of the metallic class, viz., pig iron, silver, lead and nickel. To offset this, the copper, iron ore and zinc industries exhibit increases aggregating nearly $1,500,000, leaving a minus amount of a little over $2,000,000 against the metallic class as a whole, equivalent to nearly six per cent.

Advances were shown in several of the non metallic class, notably in coal and coke, limestone, mica, salt, cement and in some of the clay products. The total growth in all the non-metallics showing increases, amounted to nearly $2,000,000, the advance in the coal and coke output accounting for over $1,000,000 of this. As against these non metallic industries showing increases, decreases are exhibited in the values of the production in asbestos, natural gas, petroleum and a

number of others aggregating about $500,000 leaving a net gain in this class of somewhat under $1,500,000, or a little over five per cent. to offset the above mentioned falling off in the metallic class, the final difference in the grand totals for the two years amounting to nearly $660,000, or a proportional decrease of close on one per cent.

Product.	Quantity. Increase.	Quantity. Decrease.	Value. Increase.	Value. Decrease.
	p.c.	p.c.	p.c.	p.c.
Metallic—				
Copper	11.54	....	26.97	....
Gold	....	....	....	11.73
Pig iron (from Canadian ore only)	....	41.32	....	32.14
Pig iron (from both home and imported ores)	....	16.77	....	11.80
Lead	....	21.59	....	18.35
Nickel	16.95	....	....	0.47
Silver	....	25.85	....	24.02
Non-metallic—				
Asbestos and asbestic	4.73	....	....	21.20
Coal	11.17	....	10.22	....
Coke	8.38	....	9.51	....
Cement	4.54	....	3.45	....

The above table gives the percentage of growth or decline in regard to the chief items in the general table. It will be noted that decreases both in quantities and values, have been the chief characteristic of the leading metallic industries with the notable exception of copper and nickel. In the latter case, however, the considerable increase in the output has been more than offset by the lower valuation which has been given to the metal following the drop in the average market price for the year. The increase in the copper output was on the other hand considerably enhanced by the higher average market price of the metal. It is interesting to note also that with regard to pig iron, lead and silver, higher market prices modified the heavy falling away in these items. The whole of the group classed as metallic, shows a decrease of 5.8 per cent.

In the non-metallic class the more important contributors are given in the table and all exhibit substantial increases in quantities, but lower prices reversed the effect in the case of asbestos and lessened the advantage gained in the case of coal and cement, coke only showing a slight advance. In the grand totals of the non-metallic class the figures for structural materials and clay products show a slight advance. In the grand totals of the non-metallic class the figures for structural materials and clay products show a slight advance of 1.5 per cent., all other non-metallics being credited with an advance of over 6.6 per cent.

Product. 1902.	Per cent. of total production.	Product. 1903.	Per cent. of total production.
1 Gold	33.41	1 Gold	29.79
2 Coal and coke	25.05	2 Coal and coke	27.87
3 Building material	8.43	3 Copper	9.06
4 Nickel	7.87	4 Building material	8.94
5 Copper	7.06	5 Nickel	7.91
6 Silver	3.51	6 Silver	2.69
7 Asbestos	1.80	7 Cement	1.84
8 Cement	1.77	8 Petroleum	1.46
9 Pig iron (from Canadian ore)	1.63	9 Iron ore (export)	1.46
10 Petroleum	1.48	10 Asbestos	1.42
11 Lead	1.46	11 Lead	1.21
12 Iron ore (not used in making pig iron in Canada	1.09	12 Pig iron (from Canadian ore)	1.12

The relative importance of the different mineral industries contributing to the grand total will be apparent from an inspection of the above table in which the figures account for all but about 5 per cent. of the aggregate. As usual gold together with coal and coke constitute Canada's most valuable mineral assets and account for 57.66 per cent. of the value of the whole mineral output of the country. To the metallic class as a whole must be credited 53.31 per cent. of the mineral output, the structural material division contributing 13.15 per cent. and the other non-metallic products a little over one-third or 33.53 per cent. The per capita value of the total mineral products for 1903 was $11.29, as compared with $2.23 in 1886, the first year for which figures are available.

Gold.—A decrease of over two and a half million dollars is shown, of which two and a quarter millions is to be ascribed to the decreased output from the Yukon District, leaving approximately a quarter of a million falling off in the other provinces. The Yukon output for the year. $12,250,000, is based on the receipts of Canadian Yukon gold at the United States mint, at San Francisco. and other receiving offices. The contributors to the total, as formerly, were Nova Scotia, Quebec, Ontario, Saskatchewan, the Yukon Territory and British Columbia.

Silver.—Silver production, according to present indications, shows a considerable decrease, over a million ounces, compared with last year's output. Over 90 per cent. of the production is obtained from British Columbia.

Lead.—The production of lead in 1903 has been estimated at about 9,000 tons. The exports, according to custom returns, were 9,314 tons, valued at $426,466. The production is practically all the output of British Columbia mines, no returns having been received of production in Eastern Canada.

Copper.—The copper contained in ore, matte, etc., shipped from Canadian mines in 1903, was about 21,640 tons, an increase of 2,238 tons or over 11.5 per cent. over the previous year's output. In Ontario and Quebec there was little change, perhaps a slight falling off, the increase being practically all in British Columbia. From the Sudbury district, Ontario, about 13,832 tons of high grade matte were shipped containing 3,576 tons of copper. (See further under nickel.) In British Columbia shipments of ore from the boundary district were approximately 625,000 tons in 1903 and from Rossland about 377,000 tons. For statistical purposes the copper is valued at the average price for the year of electrolytic copper in New York, viz., 13.235 cents per pound. This is an increase on the average price for 1902 of nearly 14 per cent.

Nickel.—The following were the results of operations on the nickel copper deposits in 1903:

	Tons.
Ore mined	136,033
Ore smelted	207,030
Matte shipped	13,832
Matte in stock at end of year	1,246
Copper contents of matte shipped	3,576
Nickel contents of matte shipped	6,258
Value of matte shipped	$2,686,469

According to customs returns exports of nickel were as follows:

	Lbs.
To Great Britain	1,335,677
United States	11,363,470
Other countries	80
Total	12,699,227

Zinc.—About 1,000 tons of zinc ore, worth $10,500 were shipped to Swansea, Wales, from the Long Lake zinc mine in the County of Frontenac, Ont. No returns have been received of zinc production in British Columbia.

Iron.—Exports of iron ore were 368,233 tons valued at $922,521. About 81,035 tons of iron ore from Canadian mines were charged to blast furnaces in Canada and valued at the furnace at about $247,229. In addition to the above Canadian ore, 485,911 tons of imported ore valued at $823,147 were used in Canadian furnaces. The total quantity of pig iron manufactured from both Canadian and imported ores was

297,885 tons of which 19,614 tons were made with charcoal as fuel and 278,271 tons with coke.

Arsenic.—The arsenic plant at Deloro, Ont., was worked for three months only producing 257 tons of white arsenic valued at $15,420. Exports of arsenic were 198 tons valued at $10,583.

Coal and Coke.—An increased production is reported from all the provinces in which coal mining is being carried on.

The Dominion Coal Company, the largest producing company in Nova Scotia, increased its output notwithstanding the serious check caused by the fire in Dominion No. 1 colliery in March. The Nova Scotia Steel and Coal Company also shows a very largely increased output from their Sydney mines. Considerable activity has been displayed in the operation of the mines in the North-West Territories, especially on the eastern slope of the Rocky Mountains in the district about Blairmore. In British Columbia the output of the Crow's Nest Pass Coal Company exceeded that of 1902 by 49.8 per cent. and the company has made substantial progress in the development of their properties. On the coast the Western Fuel Company are actively operating and developing the properties formerly worked by the New Vancouver Coal, Mining and Land Co. The Wellington Colliery Company have been opening up a seam of anthracite coal from which it is expected shipments will soon be made.

Corundum.—Returns have not yet been received of production of corundum, but railway shipments at Barry's Bay are reported at 1,090 tons, which may, however, include corundum ore as well as grain corundum.

Asbestos.—The production of asbestos divided into crude and mill stock was as follows:

	Tons.	
Crude	3,134	$361,867
Mill stock	27,995	554,021
Total	31,129	$915,888

Exports of asbestos according to customs returns were 31,780 tons valued at $891,033. The product was all obtained from the Eastern Townships, Quebec.

Cement.—The production of natural rock cement is at present small in comparison with the output of Portland, and the sales in 1903 were less by 35,679 barrels than in 1902. Detailed statistics for 1903 were as follows:

Cement sold during the year	92,252 brls.	valued at $75,655.
Cement manufactured	96,152 "	
Stock on hand, January 1st, 1903	23,000 "	
Stock on hand, Dec. 30th, 1903	26,000 "	
Wages paid	$29,550	

Portland cement statistics have been partially estimated in the absence of complete returns. The following is probably a close approximation:

Portland cement sold	627,741 brls.	valued at $1,090,842.
Portland cement manufactured	714,136 "	
Stock on hand, Jan. 1st, 1903	41,991 "	
Stock on hand, Dec. 31st, 1903	128,386 "	
Wages paid about	$400,000	

The imports of Portland cement in 1903 were:

	Cwt.	
Six months ending June	1,061,358	$385,216
Six months ending December	1,646,516	674,880
Total	2,707,874	$1,060,096

This importation is equivalent to about 773,678 barrels of 350 pounds each.

EXPORTS OF PRODUCTS OF THE MINE, CALENDAR YEAR, 1903.

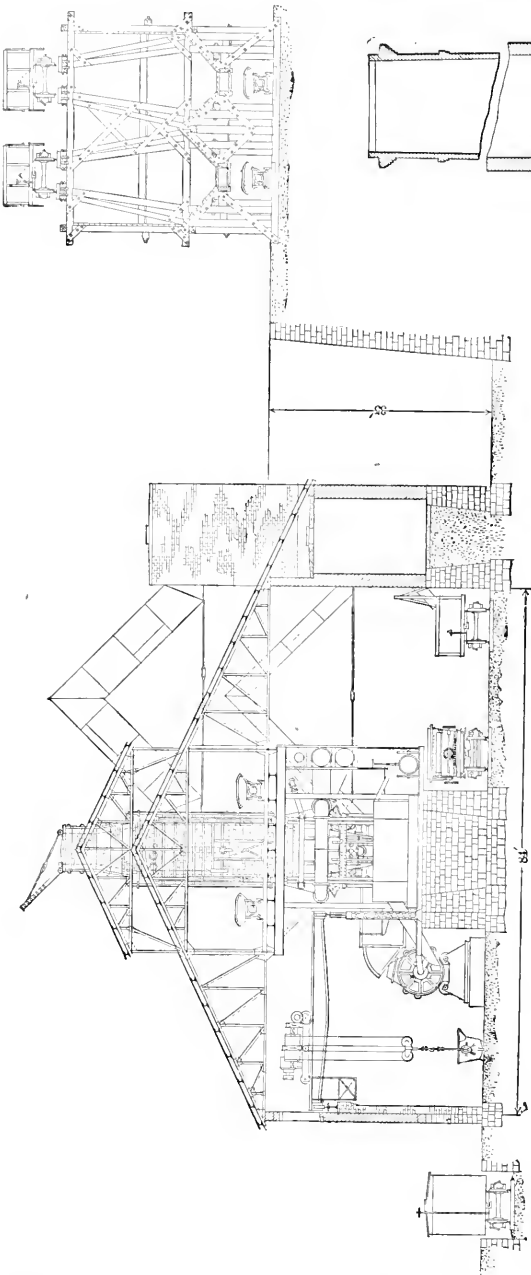
Product.	Quantity.	Value. $
Arsenic, lbs.	395,573	10,583
Asbestos, tons	31,780	891,033
Barytes, cwt.	406	368
Coal, tons	1,954,?29	[illegible]
Chromite, tons	1,013	[illegible]
Felspar, tons	13,766	[illegible]
Gold-bearing quartz, dust, nuggets, etc., dollars	....	[illegible]
Gypsum, crude, tons	....	...
Copper, fine, in ore, etc., lbs.	37,039,[illegible]75	[illegible]
Copper, black or coarse, cement copper and copper in pigs, lbs.	203,701	25,22[illegible]
Lead in ore, etc., lbs.	18,624,303	426,466
Nickel in ore matte, etc., lbs.	12,699,227	1,116,099
Platinum in ore, concentrates, etc., oz.	283	304
Silver in ore, etc., oz.	3,360,192	1,989,474
Mica, lbs.	956,244	196,020
Mineral pigments, lbs.	1,351,475	12,770
Mineral water, gals.	5,709	3,585
Oil—		
Crude, gals.	350	15
Refined, gals.	1,013	190
Ores—		
Antimony, tons	33	4,332
Iron, tons	368,233	922,571
Manganese, tons	135	1,889
Other, tons	4,942	143,470
Phosphate, tons	1	20
Plumbago, crude, cwt.	8,235	26,230
Pyrites, tons	2,067	59,604
Salt, lbs.	11,915,648	5,927
Sand and gravel, tons	355,792	124,006
Stone, building, tons	140,476	45,512
Stone, ornamental, tons	129	783
Stone, for manufacturing of grindstones, tons	2,019	16,925
Other products of the mine	....	157,568
Manufactures—		
Bricks, m.	801	5,699
Cement, dollars	....	2,851
Coke, tons	32,608	135,957
Grindstones, mfd., dollars	....	10,734
Gypsum, ground, dollars	....	12,457
Iron and Steel—		
Stoves, No.	960	11,718
Castings, dollars	....	138,352
Pig iron, tons	4,400	78,382
Machinery, N.E.S., dollars	....	410,397
Scrap iron or steel, cwt.	131,263	88,839
Hardware, N.E.S., dollars	....	88,285
Steel and manufactures of, dollars	....	2,078,328
Lime, dollars	....	131,412
Metals, N.O.P., dollars	....	554,900
Plumbago, manufactures of, dollars	....	17,412
Stone, ornamental, dollars	....	7,097
Stone, building, dollars	....	587

CANADIAN COPPER COMPANY'S PLANT, COPPER CLIFF.

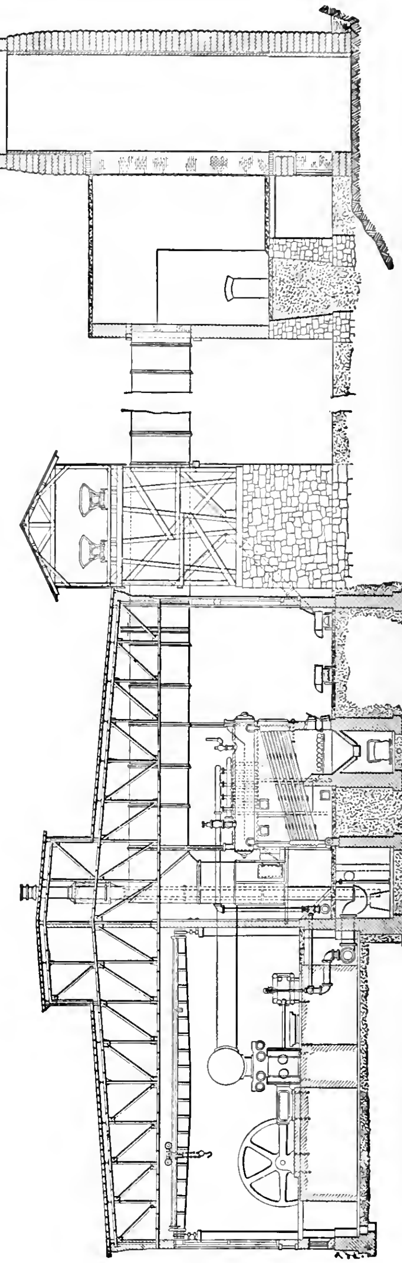
The drawings shown herewith are plan and sectional elevations of a 1,000-ton smelter designed by the Engineering Company of America, New York, and erected at Copper Cliff, Ontario, for the Canadian Copper Company, a subsidiary corporation of the International Nickel Company of New York.

There were several objects that had to be borne in mind, among them the cheap handling of a large tonnage of ore, the storage during the winter months of materials such as coke and coal, which can be received by boat during summer; the elimination of all needless manual labor, and the thorough efficiency of the power department. The plant was designed to be erected on two levels; the large amount of slag produced had to be taken into consideration and the disposition of this slag was an important factor in determining the site. The plant, as it now stands, was built along the face of a cliff on the northern side of the deep valley in which the town of Copper Cliff stands.

The problem was to take the roasted pyrrhotite from roast heaps and convert it into 80 per cent. matte, the presence of nickel precluding the advisability of a higher concentration. On the upper edge of the cliff a system of bins has been constructed for storage purposes. The smelter building proper is situated parallel to these bins with the power-house at the eastern end. A trestle was built on the grade level of the bottom of the bins, which is also the grade level of the charging floor, connecting the charging floor and drawn up to the top of the bins. The track leading to the top of the trestle is on an easy grade all the way, and is also connected with the main track leading to the Canadian Pacific Railway. All ore, flux, coke, coal, etc., is handled on these tracks and dumped directly into the bins. Running on the circular track underneath the bins and into the smelter building and past the power-house is an electric railroad, with side-dumping cars drawn by electric locomotives. The ore, coke, etc., is loaded into these cars, weighed on the end



Section of Smelter at Copper Cliff.

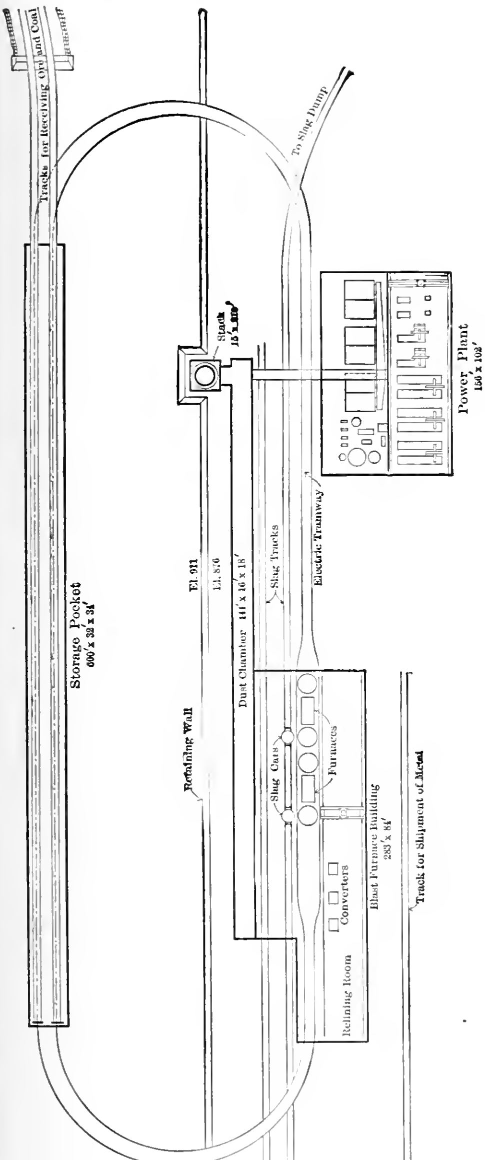


Section of Works at Copper Cliff.

with the bins and also with the power-house, making a circular track, without switches, running on both sides of the furnaces and passing the coal chute in front of the power-house, which leads directly into the boiler room. The scheme of operation is as follows: Three miles from the plant is the largest mine. The ore is taken from this mine to the roasting-beds, which are about one-half mile from the smelter. After roasting, the ore is loaded into hopper-bottom cars of the trestle and dumped into the coal chute next to the power-house. All trains are kept moving in one direction, and there is no switching or cross-over.

As shown by the sectional elevations, the site consists of two levels with a difference of 35 ft. in elevation. The upper elevation is in the same elevation as the feed-floor, and is occupied by a double-track pocket trestle 32 by 34 by 600 feet. The storage pockets were made to hold enough coal

to last over the period of closed navigation; coal being received by boat at a near-by port on Georgian Bay, as well as coke, ore, silica and clay. On the lower level are located the power-house, 156 by 102 feet; the blast-furnace building, 84 by 283 feet; the foundations for the trestle carrying the electric tramway, connecting the storage pockets with the feed-floor; the coal-bins of the boiler-room; the dust-chamber, 16 feet wide, 18 feet high and 444 feet long; the stack, 15 feet inside diameter, 210 feet high; together with the necessary slag tracks, sunken track for loading metal for shipment, tracks to storehouse, etc.



Plans of Works at Copper Cliff.

The power-house is equipped with two horizontal, cross-compound, condensing blowing engines with steam cylinders 13 in. and 24 in. by 42 in. and air cylinders 57 in. and 57 in. by 42 in. When operating under usual working conditions these engines will deliver 20,000 cub. ft. of free air per minute against a pressure of 40 oz. for use in the blast furnaces. Another blowing engine, with steam cylinders 15 in. and 30 in. by 42 in. and air cylinders 40 in. and 40 in. by 42 in. will deliver 10,000 cub. ft. of free air per minute against a pressure of 15 lbs. for use in the converters. Two 13 in. by 26 in. by 20 in. horizontal compound condensing engines built by the Robb Engineering Company, of Amherst, N.S., to each of which is directly connected one 200-K.W., 600-volt, three-phase alternating current generator built by the Canadian General Electric Company, each generator having its own exciter of 11-K.W. capacity belt driven from generator shaft. The electrical energy thus generated is used for hoisting and pumping the mines, operating the electric tramway for charging cars, turning the converters, and operating the travelling crane in furnace building. The station is also equipped with one 25-K.W. motor driven generator set, for furnishing direct current to the electric locomotives. A travelling crane of ample capacity is installed in the engine room for handling all this apparatus. A gravity oiling and filtration system is installed on all engines.

Coal is brought to the power plant by the electric locomotive train above referred to and dumped into bins built in trestle along the west side of building. Then it runs through coal chutes to one-half-ton coal cars in boiler room, from which cars it is shovelled into boiler furnaces. The only available water for boiler use contains considerable sulphuric acid and scale-forming elements, and, to eliminate these, the water is subjected to a chemical treatment and precipitation in a water purifying system. In this way the acid is neutralized and the scale-forming material is removed before the water enters the boilers.

The blast furnace building contains two Holthoff copper blast furnaces; three stands for Holthoff converters; one 40-ton electric crane; the necessary matte-settlers, clay drills, silica and clay storage bins, etc. Room is provided for expansion.

In operation the ore, coke and flux for blast furnaces, silica, and clay for lining converters and coal for boilers is delivered into the top of the trestle pockets by standard gauge cars—Ingoldsby side-dumping in the case of ore—and drawn from the bottom of the pockets into trains of six 2-ton, 36-in. gauge, side-dump cars, made by Arthur Koppel, New York, which are hauled to the blast furnace, silica and clay storage bins or coal bins by 25-h.p. Canadian General Electric Company electric locomotives. When feeding the blast furnaces, a train of six cars will be made up of four cars containing two tons of smelting mixture and two cars each containing the proper amount of coke to go with four tons of charge.

The slag and matte runs from the blast furnace into 16-in. settlers, the slag overflowing into 225 cub. ft. capacity Pollock cinder cars, which are hauled to the dump by standard gauge locomotives. The matte is tapped into 10-ton cast steel ladles and taken to the converter by a 40-ton Case Manufacturing Company's electric crane. The same crane removes the converter shells for relining, and takes care of the converter slag and white metal, pouring them into molds for return into the pocket trestle, or for shipment to the refinery. The coal bins at the boilers and the silica and clay bins at the clay mills are kept full by six-car train-loads of material.

The flue dust is drawn from the dust chamber into a standard gauge, bottom-dump gondola especially fitted for the service, and this car is hauled to the top of the pocket trestle on the upper level and the dust drawn into a pocket fitted for that purpose, whence it is drawn to a briquetting machine, pressed into briquettes and added to the charge.

The electric tramway consists of two parallel 36-in. gauge tracks running under two lines of grates under the pocket trestle, then over suspension scales to opposite sides of the furnaces on the feed floor level, passing over the top of the boiler room coal bins and converter lining house, silica and clay bins. The two tracks have cross-over connections, but under normal working conditions each track carries a train entirely independent of the other.

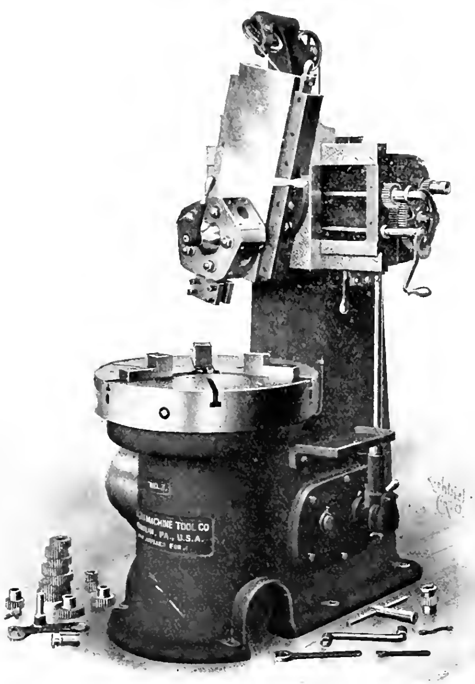
The blast furnaces are 50 in. by 204 in. at the tuyeres; 14 feet 9 in. from centre of tuyeres to the feed floor, and have on each side four lower jackets each 51 in. wide and 8 ft. 6 in. high, and two upper jackets 8 ft. 6 in. wide and 6 ft. high. Each lower side jacket carries four 6-in. tuyeres.

Both ends of the furnace are made alike, so that either end can be used for removing matte and slag. There is no brick work under the deck beams. The converters are 84 in. by 126 in. and are tilted by a train of gears and a worm, driven by the electric motor.

The water for the plant is supplied by a 16-in. diameter pipe running from a dam situated about 5,000 feet from the plant itself. The water is run by gravity into the jackets, and when drawn out is pumped into a tank above the smelting plant for fire purposes or into the reservoir, which is near the foot of the plant, and the hot water is also used in the boilers in order to economize at that point.---Correspondence, Engineering and Mines Journal.

VERTICAL BORING AND TURNING MILL.

Vertical boring and turning mills have rapidly come into use in many large as well as small machine shops throughout the country during the past few years, and their value as manufacturing tools is daily being more fully demonstrated. Their function is not so much to replace the lathe, but rather to do a variety of work such as chucking, boring and turning, etc., which can be performed more rapidly, economically and easier than on any other type of machine. The facility with which work can be placed on the table of a mill and held until ready for chucking and centering is in itself of no inconsiderable importance in shop economy, where increased production is a factor which receives careful attention. This condition prevails more generally to-day than ever before and in the struggle for supremacy may determine the success or failure of a shop. The accompanying cut shows a 34-inch Vertical Boring and Turning Mill, built by the Colburn Machine Tool Company, Franklin, Pa.



It has a capacity of 34 inches in diameter and will take work under the cross-rail 14 inches high. It has 16 changes of speed varying from 2⅜ to 68⅜ revolutions per minute. This affords as great range as is necessary for any work which would ordinarily be done on this size tool. The feeds, both vertical and horizontal, are positive, gear driven, and are provided with adjustable automatic stops. There are eight available changes of feed for each speed of the table. Feeds range from .012 to .125 of an inch in vertical or angular directions and from .025 to .250 of an inch in horizontal direction. The makers of this mill are prepared to furnish either three or four jaw chuck, or plain table, as the user may elect. The driving cone shaft is placed parallel with the cross-rail so that the machine may be located under a travelling crane and belted back to the countershaft, leaving a free space overhead for crane service. The ratio of back gearing is 21 to 1, and the 16 changes of speed are graded in perfect geometrical progression. The vertical slide has a travel of 18 inches, either by hand or power and is carried in a swivel saddle attached to the turret slide by a central stud. The saddle is clamped to the cross slide by four bolts working in a circular T slot. When the power feed is used an adjustable automatic stop regulates the length of travel as desired. An excellent feature of this tool is the graduated scale 18 inches long, which is attached to the turret slide cap parallel with the turret slide. The latter has an adjustable pointer which moves over the scale indicating at all times the travel of turret slide. The counterbalance weight is suspended within the column and is carried in such manner as to do away entirely with awkward overhanging arms, as frequently employed. The turret can be swiveled to any angle up to 30 degrees either side of the perpendicular, has a travel of 15½-in. by hand or power, and is equipped with stops for tripping feed. The turret is five-sided and holes are bored to fit tool shanks 2¼-in. in diameter. The lock bolt is of hardened tool steel, ground perfectly true. It works in a hardened tool steel ring also accurately ground. A micrometer dial is furnished, which is a great convenience, providing a fine adjustment for depth of cut. The thread cutting attachment may be quickly applied and remain permanently attached to the machine without interfering with its regular operation. In addition to this 34-in. mill, the Colburn Machine Tool Co. built several sizes up to 6 ft. swing.

FATHER OF A GREAT INDUSTRY.

Joseph Dixon, founder of the Joseph Dixon Crucible Co., was a native-born Yankee, first seeing the light of day at Marblehead, Mass., in the last year of the eighteenth century. He was a genius whose ability was almost equalled by his extraordinary versatility. In almost all his many occupations he was a pioneer and inventor, and the strength and power of his features discloses the rugged strength of this man who so often had the courage and ingenuity to depart from old and accepted ways of doing things. One after another he took up new interests applying to each his mechanical genius. In every instance he made himself felt and

JOSEPH DIXON.

marked his progress with many new and valuable additions to knowledge and methods. "Before he was twenty-one he invented a machine to cut files; afterwards he learned the printer's trade, then wood engraving, then lithography, and became a thorough chemist, optician, and photographer. He was probably the first to take a portrait by the camera; he

first used the reflector, so that the subjects should not appear to be reversed. He built the first locomotive with wooden wheels, but with the same double crank now used. He originated the process of photo-lithography. To guard against abuses of this process, he invented the system of printing in colors on bank notes and patented it, but never received any benefit, all the banks having used it without pay. He perfected the system of making collodion for the photographers, and aided Mr. Harrison in the mode of grinding lenses for camera tubes."

Perhaps his greatest invention was that of the plumbago crucible, as used to-day, and thereby he revolutionized the metallurgical industry of the world and laid the foundation of his large fortune. In 1827 he was established in the manufacture of crucibles and shortly thereafter moved to its present location in Jersey City. The Joseph Dixon Crucible Company was incorporated in 1868, and has grown steadily year by year to its present magnitude. One by one new uses have been found for graphite, and in this field the Dixon Company has always been the pioneer. Stove polish, pencils, paint, lubricants and half a hundred specialties has this marvellous mineral graphite yielded, and each succeeding year has brought forth new uses and new Dixon products.

To-day, the Dixon factories turn out almost three hundred pencils for every working minute, and seven hundred different pencils are regularly made. They own their mines and are also importers so that the exact quality of graphite is provided for the peculiar needs of each application of it. It is very necessary in the manufacture of graphite products that the form and size and chemical analysis of the mineral be exactly adapted to the work in hand. Graphite for lubrication purposes must be of the flake formation as the amorphous is always associated in nature with earthy impurities from which it cannot be separated. Even the Flake Graphite from the Dixon mines has to be carefully milled to wholly free it from the silicates with which it occurs and the processes call for great skill and experience and much elaborate equipment. It is almost impossible to detect impure from pure graphite by the appearance or feeling and the only safe way to avoid the mishaps that will surely follow the application of a gritty lubricating graphite, is to refuse anything but a responsible manufacturer's original packages. The history of the graphite industry can almost be written in the records of the Joseph Dixon Crucible Company, and "Graphite" has come to mean "Dixon" the world over. The company issues a good deal of useful literature on the uses of graphite, alone or in combination with other substances as a crucible mixture, stove polish, protective paint, lubricant, pencil "lead" or electrical specialty, and will no doubt respond to enquiries on these subjects from interested readers.

STREET CAR WHEELS AND TYRES.

R. H. Simpson discusses in The Light Railway and Tramway Journal, of London, the merits of steel tyred and chilled iron wheels. He says:

In view of the present tendency towards equipping cars with steel-tyred wheels, it may be interesting to take up a few points with regard to them. Careful consideration should be given to the question of diameter before specifying the size with which the truck is to be fitted. In America the standard wheel diameter is 33 in., and the type of wheel used is invariably the chilled one. In this country the diameter up to the present time has generally been 30 in., and also that of the chilled iron type. Amongst others, there are two reasons for the adoption of this diameter: one, a relict of the days of horse traction, and the other, that with this diameter the height from the ground to the steps is reduced to a reasonable figure. It is generally known that with 30 in. wheels and with most manufacturers' motors there is not more than from 2¾ to 3 in. difference between the underside of the motor or gear case and the top of the rail head, and it is also invariably found in practice that this dimension does not obtain in the centre of the track between the rails, as the paving, whether of stone setts or wood blocks, is crowned at least ½ in. Besides this, the paving rises after a short time, and it is difficult to prevent it from doing so; therefore, with new wheels 30 in. in diameter, there will be less clearance than stated above. It is not possible to wear down a chilled wheel 30 in. in diameter to less than 28¾ or 28½ in. on account of getting below the depth of the chill, which is only from [illegible] to ⅞ in. deep; also the clearance between the motor and the ground becomes too small—some 2 in. or so. In changing from cast-iron wheels to steel-tyred, the diameter should be increased for this reason: the steel tyre, which is usually 2½ in. deep, allows a greater depth to be worn down, say to 1½ or 1¾ in. on the radius, instead of [illegible] to [illegible] in. in the case of the chilled wheel, and if a 30 in. steel-tyred wheel is employed, the motor will be down on the track before the full life of the tyre can be obtained. This result will be seen to be extremely uneconomical. For this reason the writer advocates the use of a wheel of not less than 31¾ in. in diameter when steel-tyred, which size is in use on several existing tramways. It will, therefore, be seen that it is useless going to the expense of a steel tyre with a depth of 2½ in., which is the minimum, if it cannot be worn down to its working limit on account of the smallness in diameter bringing the motor down on the road. The objection that a larger diameter wheel raises the height of the steps can be easily remedied if these two points are considered together when designing the car underframe, and, as a matter of fact, there are cars running already with wheels 31¾, 32, and even 33 in. in diameter, in which this trouble has been eliminated.

STEEL-TYRED VS. IRON CHILLED WHEELS.

This subject requires thought and experience before an opinion can be expressed; each type has its merits, but the conditions of working should be considered before deciding upon the type of wheel to be installed. The writer has not been able to ascertain that both types of wheel have been run over the same line under equal conditions, and would be glad to be informed if such had been the case. By equal conditions is meant a new track carefully laid and thought out, with the same section of rail throughout, the gauge constant, wheel base of truck arranged to suit the minimum curves, and whether single or double track cars in either case; as regards the wheels themselves, the section of tread designed to suit the rail on which it has to run, especially in respect to the thickness of the flange; and lastly, the correct wheel gauge to which the wheels should be pressed on. The writer is of opinion that, with all points taken into consideration, the difference it costs between the two types of wheels would not amount to a great deal. It is very well known that on those lines where trouble has been experienced with chilled wheels, due to the flanges chipping, it has not been so much the fault of the wheels themselves as the condition of the track over which they have had to run; also, that some engineers insist on their own design of tread instead of leaving this detail to the wheel manufacturer. While on this point of section of tread, I think it is now quite time that a standard section should be agreed upon, taking into consideration that in the near future cars owned by various corporations and private companies will be running over one another's lines. It is argued that steel wheels have stronger centres than chilled ones; this may be so, but there have been few failures in this respect with the chilled wheel. The steel-tyred wheel appeals more to the mechanical engineer, especially to the steam or railway man, who has been used to these wheels on his steam locomotives, but whichever wheel is adopted much depends on the quality and price of the wheel purchased, the amount of attention it receives, the gradients over which it has to run, the condition of the permanent way, the radii of the curves, whether electric braking is used extensively or not, and to the skill (or lack of it) on the part of the motormen, all of which vary considerably. On a road which is properly managed, both as to upkeep of rolling stock and education of its drivers, it will be found that not only wheels, but other renewable parts, last some 50 per cent. longer, and even more, than on those lines which are left practically to run themselves till something gives out. The writer has noticed that with steel-tyred wheels the flange has sometimes worn hollow at the throat, but this has usually happened on bogie trucks, which have had insufficient lubrication on their side bearings, causing them to work stiffly, the truck consequently not adjusting itself to the track after having passed round curves.

The comparative cost of steel-tyred and cast-iron wheels, as here given (sterling money being converted to Canadian), is based on a two years' working, and for a total mileage of 60,000 miles for the two years. The scrap value of the cast-iron wheels is taken into account in the sum allowed for new wheels. It will also be noted that an amount of $9.73 per wheel has been allowed in the case of the steel-tyred wheels as the value of the centres, which point has been entirely overlooked in all previous articles dealing with the advantage of one type of wheel over the other. A sum of $4.87 per car has been allowed for re-turning steel tyres after one year's working, which could be omitted, as in many cases these wheels run the full mileage without returning, but it is safer to let this sum stand. No allowance has been made for taking out or replacing the wheels and axles, as in all well-managed car sheds these come out in any case for examination of axle boxes, etc. A year's working has been taken as 30,000 miles, as this mileage is a fair average for a car in most districts.

STEEL-TYRED WHEELS.

One set of four wheels at $19.47 each	$77 86
Re-turning at end of first year's working and 30,000 miles' wear, which in several cases has not been necessary	4 87
Total cost at end of second year's working and 60,000 miles' wear, tyres now worn out	82 73
One set of new tyres at about $9.73 each	38 93
Re-turning at end of third year's working and 30,000 miles' wear	4 87
Total cost at end of fourth year's working and 60,000 miles' wear, tyres now worn out for the second time	126 53
Value of the four wheel centres	38 93
Cost of wheels at end of fourth year, after allowing for material not requiring to be scrapped	87 60

CHILLED CAST-IRON WHEELS.

One set of four wheels at $5.36 each, after allowing for their scrap value	21 42
Four new wheels, with refitting on axles, at end of first year's working and 30,000 miles' wear	28 71
Total cost at end of second year's working and 60,000 miles' wear	50 13
Four new wheels, etc., at end of second year's working	28 71
Ditto at end of third year and 30,000 miles	28 71
Total cost at end of fourth year's working and 60,000 miles' wear, a new wheel being required at the end of each year and 30,000 miles' wear	107 55

The foregoing figures show a saving at the end of two years of $6.33 per car, and at the end of four years $19.47 per car in the case of steel-tyred wheels, and is brought about entirely by allowing for the value of the wheel centre, which can be retained on the axle and does not depreciate. The figures have been carefully gone into, and facts obtained from an entirely unbiassed standpoint.

The following gives particulars of steel-tyred and chilled iron wheels manufactured by Hadfield's Steel Foundry Co., for whom Peacock Bros., of Montreal, are Canadian agents. These wheels consist of a cast steel centre, on which is fitted a renewable steel tyre.

Centres.—The centres are made of Hadfield's best toughened cast steel of a special grade. They are capable of withstanding a test load, applied by steady pressure to the centre of the boss, of about 112,000 lbs. without producing any permanent set, and will withstand a load of about 179,200 lbs. applied in the same manner, without showing signs of fracture. The centres are carefully turned up and recessed on the front side of the rim, the back edge being slightly tapered off. The boss is faced on both sides and bored for the axle.

Tyres.—These are 2½ to 2¾-in. thick, and are constructed of a specially hard and toughened rolled steel, having a tensile strength of 112,000 to 123,200 lbs. per square inch, with an elongation of 67,200 lbs. per cent. in 2-in. The tyre is carefully heated and shrunk on the centre mentioned above. The wheel is then placed in a lathe and has the projection on the back edge of the tyre folded over by a special appliance. In this way the tyre is so fixed that it is impossible for it to become loose laterally. The complete wheel is pressed on to the axle at a pressure of not less than 67,200 lbs.

Mileage.—These tyres will give a mileage of about 60,000 miles before requiring to be renewed. The wear for this mileage will be from 1½ to 1¾in. on the radius or ¼-in. on the diameter for every 5,000 miles run. At Sheffield, where the conditions are severe, due to the steep gradients, the average life has come out at 65,000 to 70,000 miles.

Weight.—The average weight of a 31¾-in. wheel is approximately 330 lbs.

Axles.—These are of a special quality of best toughened steel, and so far there is no breakage on record against these axles.

THE "ANGUS SHOPS" OF THE CANADIAN PACIFIC RAILWAY.

From a Paper read before the Canadian Society of Civil Engineers.

BY HENRY GOLDMARK, C.E., ENGINEER IN CHARGE OF CONSTRUCTION.

(Concluded from March issue).

It may be added that the wooden Howe trusses in the car shop were adopted instead of steel trusses mainly to save time. The saving in cost did not exceed 12½ per cent. In the outcome there was probably no saving of time from the use of timber, but on the other hand no great disadvantage resulted from using this form of construction.

The heavy timber girder and post construction as used in the truck shop, etc., was adopted as being cheaper and better than truss work, and its use is believed to be fully justified.

The principles of mill construction were fully carried out, the purlins being in no cases less than 6 by 12-in. and in many buildings 8 by 16-in. They are spaced from 8 to 10 feet apart. The roof boards are 3-in. thick in all cases.

In the locomotive shop they are 11-in. wide, T. and G. In most of the other buildings this roofing was built up of strips of 3 by 3-in. laid with broken joints in random lengths and well nailed horizontally and vertically. These strips were surfaced on three sides, but were not tongued and grooved. On top of the boards a four-ply tar and gravel roofing of standard construction was laid. There is a galvanized iron flashing around the skylight, but there are no gutters or downspouts.

The flooring throughout consists of three-inch unmatched plank nailed to cedar sleepers 4 feet apart and bedded in from 15 to 18 inches of cinders. It may be added that the roof loads were taken at 70 lbs. per square foot. (total loading), and the stresses in the timber beams at 1,500 lbs. per sq. inch. The structural steel is of simple construction though every attempt was made to secure rigidity especially where crane runways had to be supported. Tensile stresses are 15,000 lbs. per sq. inch on the net section and compressile stresses 12,000 lbs. reduced for length. In the crane runway girders the tensile stresses were reduced to 12,500 lbs. per sq. inch.

HEATING.

The heating of the shops was the subject of an extended study in order to determine the most practicable and feasible system. This question was necessarily taken up in connection with the design of the power plant. The economy of producing power in an independent station is dependent on the utilization of the exhaust steam of heating. As exhaust steam possesses from 85 to 90 per cent. of the heat units contained in the steam before it has passed through the engines, it is clear that every consideration of economy will lead to its utilization if possible. Whether any additional boilers will be required over and above those necessary for power will depend, of course, on the amount of power, the size of the shops, and the prevailing temperature. In the "Angus" shop, about 26,000,000 cubic feet had to be heated in the various shops, while the horse-power installed in the engine room of the power-house is nearly 3,000.

A somewhat careful calculation, based upon the prevailing practice, and a study of the temperatures in Montreal, as recorded by McGill University for many years past, led to the conclusion that about 2,400 boiler horse-power would be required, and that the heating requirements were very nearly the same as the power requirements under average weather conditions. The choice lay between three systems of heating—the hot blast or Sturtevant system, ordinary direct steam radiation, and a hot water system. In the first, exhaust and live steam are taken to one or more points in each building and used there to heat coils of steam pipe and also to drive a small engine operating a fan. Air is taken either from outdoor or from the inside of the building, drawn by the fan over the heating coils so as to be warmed to about 130 degrees, and then blown through ducts over or above ground to different parts of the building. This is the system finally adopted for all the buildings though the hot water system presented some advantages. The requisite radiating surface for heating by hot water is, however, difficult to obtain, and the cost of the system is considerably greater.

In the arrangement of the pipes, care was taken to proportion them in such a way as to utilize the exhaust steam as much as possible. In extreme weather certain portions of the buildings will have to be heated by live steam by day as well as by night.

A considerable amount of economy was possible in proportioning the pipes to fit the estimated amount of exhaust steam rather than the total that might possibly be available.

The steam pipes are carried from the power-house to the several buildings in a tunnel 6-ft. high and 4½-ft. wide, built of brick. A few of the smaller mains are, however, carried under ground in wooden boxes.

POWER PLANT.

All power, whether for mechanical or lighting purposes, is generated in the central power plant. This contains four 415-h.p. Babcock & Wilcox boilers of 150 lbs.' pressure, 150 degrees superheat and one B. & W. boiler that can be raised to a pressure of 300 lbs. for test in the completed locomotive boilers in the boiler shop, a special 4-in. main being led to that point. A "Green" economizer is used and a Sturtevant induced draft fan and stack. The engine and generator equipment is as follows: Three 750-h.p. Cross compound engines, non-condensing, connected to 500 K.W. alternating current generators. These have a voltage of 600 and a frequency of 7,200 alternations per minute. The speed of the units is 150. An auxiliary unit of half this size with a simple engine is provided. These generators provide all current for lighting as well as for power, excepting that necessary for cranes and a limited number of variable speed tools. For these, two units are provided each being a 300-h.p. simple engine direct connected to a D.C. generator producing 250 volts. The speed of these engines is 180.

The distribution from the power house to the different shops is by bare wire on steel poles. The motor equipment is not yet fully worked out. The larger engines will have individual motors, but group driving will be used for smaller tools, the smallest motor being 10-h.p.

The sewerage system is rather extensive but simple in its character. Two main sewers are carried transversely, connecting with the city sewer on Nolan St. They begin with a diameter of 8-in. at the northern part of the grounds, and increase to 3 ft. by 2 ft. They are connected with all lavatories, etc., and also serve to a limited extent for surface drainage.

For water supply and fire protection the city provides two systems of water mains one for ordinary use at a pressure of about 35 lbs., the other for fire purposes only with a pressure of 90 lbs. per sq. in. There are two separate systems of mains all over the grounds for these services. The supply system has a 6-in main on the midway, with smaller mains diverging to the different buildings. The fire service consists of a 12-in. main on the midway, and 8, 10 and 12-in. mains encircling the various buildings. About 60 three-way hydrants are placed at different points in the grounds, and are about 150 feet apart. With the fire mains is also connected the sprinkler system. About 13,00[illegible] sprinklers are put in all the buildings, and two [illegible] underwriters' pumps are placed in the power house as auxiliary measures. In addition to the city water supply the shops have their own supply of water which consists of [illegible] artesian wells 6-in. in diameter and 550 feet deep sunk through the limestone rock close to the power-house. It is believed that these will furnish nearly 20,000 gallons per hour of very pure water.

As a further safeguard against fire, an open reservoir 66-ft. in diameter with a capacity of 500,000 United States gallons, has been provided. A 75,000-gallon steel tank, 50-ft. in height serves to maintain a uniform head on the supply pipes and gives additional storage.

The general welfare of the employees has been looked after to an unusual degree. A very complete system of lavatories is provided; the latest sanitary plumbing will be installed, and the lavatories are in every case under the same roof as the main building, thus obviating the necessity for the men to go out of doors, which in this climate is very objectionable in winter.

The system of heating also provides most excellent ventilation. Individual clothes lockers made of open iron work will be provided to hold the men's outer clothing while they are at work; while the drinking water taken from the artesian wells will be purer than that obtainable anywhere else in the city.

It is impossible in this brief paper to refer to the machinery to be installed in the different buildings. In passing mention may be made of the wheel foundry equipment. This is the well-known Whiting rectangular system, which has been worked out with great care by the Whiting Foundry Equipment Company, and it is hoped will produce car wheels very economically and of high grade. The Grey Iron Foundry, in like manner, is to be equipped according to the latest and best practice.

The largest locomotive shop is to be fitted with latest machinery working high grade steels of the highest speeds called for by proper economy.

The boiler shop at the west end of the locomotive shop will have a 17-ft. gap hydraulic elevator with a 65-ft riveting tower for holding the 25-ton hydraulic cranes. The pressure in the accumulator will be 1,500 lbs. per square inch.

The blacksmith shop is being equipped with oil furnaces throughout. There will be an overhead system of exhausts, and a blast system for introducing air. Shavings will be removed from the planing mill and cabinet shop by the exhaust system, and carried to the power-house for consumption under several of the boilers.

PUMPING BY ELECTRICITY.*

THE CLARKE AVE. MOTOR

(Concluded.)

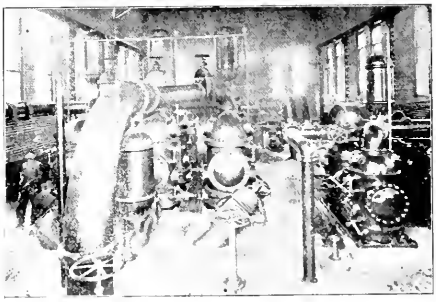
The motor is a 400-h.p., three-phase, 60-cycle, 2,200-volt, 90-amperes induction machine, having 44 poles and therefore a synchronous speed at 60 cycles of approximately 160 revolutions per minute. In order to keep up the power factor with that number of poles a very large machine with a very small air gap or clearance naturally results. The rotor is 13 feet diameter, and the stator [illegible] feet outside diameter. The clearance between rotor and stator is less than 1/10 inch. The guaranteed power factor at full load is of [illegible] per cent., full load efficiency 92 per cent., heating limit after 12 hours run 40 deg. C. temperature rise at full load. An overload of 25 per cent. for two hours should not show a temperature rise of more than 50 deg. C. at same efficiency. The above is a very liberal rating on this machine, as another 10 degrees would not be out of the way for regular running, and 550-h.p. could easily be realized at that limit. The machine passed its test satisfactorily. This and its duplicate, are the largest induction motors ever built in point of power, and are much larger in their diametrical dimensions than anything previously at-

* From a paper read before the New England Waterworks Association by F. H. Pitcher, chief engineer of the Montreal Water and Power Co.

tempted. This motor is started by first an auto starter in the stator. This is simply a series of transformers so arranged that the line voltage may be applied to the stator windings in gradual steps. This arrangement prevents the sudden rush of current so objectionable to the line and so frequently found in starting smaller induction motors. In the meantime the rotor is an open circuit, which after the full line volts have been applied to the stator is closed gradually through the resistance of a water rheostat. The starting current of this motor is only 30 amperes. It would, of course, have been preferable from an operating point of view to have had this machine two-phase like that below, but, in order to meet the condition of the electric company supplying the power, three-phase had to be adopted. This machine is considered a very satisfactory one, remembering that it was the first; the city motor has some slight mechanical improvements. There has been no trouble like that experienced below in the operation of this motor. A strong, short circuit on the line for a few moments makes no trouble in the pumping station. The starting device is much simpler and less liable to get out of order. Even if it did, the motor could still be started by applying the full line voltage at one step. This would, however, not be agreeable in all probability to the central station people.

EFFICIENCY.

With good steam coal at its present price delivered at that station, the duty of this pump corresponds to 162,000,000 foot-pounds per 100 pounds of coal approximately. The difference in duty on this basis between the two installations is due, of course, to the higher price of power below and slightly lower cost of coal—the latter on account of the difference in hauling and the former because some 24-hour power is used there. The stator is in two parts divided along a diameter. The rotor is in one piece. The diameter of the shaft through the bearings is 10 inches. The bearings are not self-aligning, which, for a direct connected machine like this, is considered an advantage. The approximate weights of the parts are as



Water End View of Electric Pumps at St. Gabriel Station.

follows: Stator—Top half, 23,500 pounds; bottom half, 29,500 pounds; rotor, 25,000 pounds. As will be observed, the peripheral speed of this machine is fairly high, being over 6,500 feet per minute. This, however, in spite of the minute clearance and large diameter of the rotor, causes no anxiety with modern methods of rotor construction. This equipment would have been most satisfactory from an operating standpoint if it had been thought possible to consider all metal gearing at the outset. Double reduction gearing was ruled out, both on account of its inefficiency, cumbersomeness, and liability to additional disturbance.

THIRD ELECTRIC PUMP.

The third electric pump was installed at the lower station, due to the following considerations: The additional force and supply mains above mentioned between the lower station and Clarke Ave. reduced the load by more than 30 per cent. on the lower motor. The power contract entitled the company to more than it was possible to use under the new conditions in the same proportion. On this account additional pumping capacity at this station was contemplated in the scheme which included additional force main capacity.

To take full advantage of the capacity of the electric motor already installed, and at the same time utilize all the power available under the old conditions, it was apparent that an additional power pump of one-half the capacity of the original low level electric pump was possible. The limits of the building did not admit of a direct connected pump. Accordingly the additional pump now running was placed "back" and rope driven from a friction clutch rope pulley carried by an extended shaft of the original 480-h.p. S.K.C. motor.

POWER PUMP AT ST. GABRIEL STATION.

The chief consideration here was compactness in proportion to capacity. A 16½-in. by 18-in. duplex, double-acting centre packed pump was adopted, having a capacity of 2,500,000 Imperial gallons. The general water end design is similar to the foregoing pumps. The pinion shaft was carried back on the cross-head guides to allow of sufficient centres for an efficient rope drive. A feature of this pump, due to the limited space available, was an annular suction air chamber, cast about a section of the 12-inch discharge pipe. The gearing is essentially a double-reduction arrangement, the ratio between the rope pulleys on the motor and on the jack shaft being 1.36, and the spur pinion and gear of the pump 4.19. The spur gearing was as follows: One mortise wheel 9 feet 11.04 inches (83.04 inches), pitch diameter, 88 teeth, 4½-in. circular pitch, 16½-in. face. Machine-cut steel pinion, 28.41-inch pitch diameter, 21 teeth. Total reduction ratio between motor and crank shaft, 5.698. Speed of crank shaft, 32 revolutions per minute. The wooden cogs fared no better than those at Clarke Ave. and failed in much the same way. A loose and badly made key of the pinion shaft pulley might be sufficient account for the failure. This gearing was, however, replaced by that now running, which consists of a machine-cut cast-iron gear with 112 involute teeth, 3.2975-in. pitch, 117.56-in. pitch diameter, 17¼-in. face, driven by a steel pinion, 29 teeth, 30.42 pitch diameter. Ratio 3.86. As far as this can be seen, this is a satisfactory arrangement. The piston speed of this pump is 96 feet per minute at 32 revolutions per minute. An additional 5,000,000 Imperial gallon electric pump is now under consideration for this station to meet the growing demand, and at the same time a 12,000,000 Imperial gallon reserve steam plant for use in emergency only.

THE MOUNTAIN SYSTEM PUMP.

The electric pump used at the Mountain System Station is a small 8 by 10-in. single-acting, vertical triplex, driven through double reduction gearing by a 7½-h.p., 500-volt, S.K.C. induction motor. The capacity of this little pump is approximately 100 Imperial gallons per minute. As mentioned above, this supplies the people living on the Westmount Mountain. There are no special features about this equipment. An exact duplicate can be seen in dozens of cotton mills, etc., throughout the country. They differ from each other only in size and type of drive. No trouble has been experienced with this apparatus.

NEW ELECTRIC PUMP FOR THE CITY OF MONTREAL.

Before closing, mention should be made of an important similar installation now being erected for the City of Montreal at its high-level station. The pump is, briefly, an 18-in. by 24-in. double-acting, horizontal triplex inside plunger packed pump. This is to deliver 5,000,000 Imperial gallons in 24 hours, and will be run at a piston speed of about 115 feet per minute. The general gearing arrangement is similar to that finally adopted at Clarke Ave., except that a hand-dressed mortise wheel and steel pinion will be used. Pitch diameter gear 188.44 inches, 148 maple teeth, 4-in. pitch, 20-in. face. Pinion, steel, 31.83 inches pitch diameter, 25 teeth. Ratio 5.9. As mentioned above, the motor is electrically identical with the Clarke Ave. machine. A change in the method of adjusting the rotor in its housings has been adopted, so that in case of wear at the journals the motor can be easily raised by the wedges and screws for the purpose. The housings or cheeks have been flared outwards and the sole plates widened to give greater stiffness.

The chief problem encountered with large reciprocating electric pumps is in suitably reducing the speed of a compar-

atively high velocity prime mover. It is undesirable at present on account of the cost, to build an induction motor to run at less than say 150 revolutions per minute with a frequency as high as 60 cycles. The more modern power installations, like that at Shawinigan Falls, generate at 30 cycles. This would be very desirable power for reciprocating electric pumps. Unfortunately such a low frequency cannot be obtained at Montreal. The Shawinigan power used in the city is transformed at a local sub-station to 60 cycles so as to coincide with the original Lachine system. The high-speed turbine pumps, so much used abroad and now being introduced into the United States, may prove, everything considered, more desirable as electrically driven pumps than the reciprocating type. The principal advantages of large electric pumps in this district are a high comparative duty, which, when the power is on a flat rate, remains absolutely constant. This is a great advantage and eliminates the personal equation of firemen and attendants. They certainly require less attendance than steam pumps of an equal capacity beyond the small sizes. They are clean and generally cause less annoyance to surrounding property-holders. They run with less oil and waste. In this district, with the larger sizes, the capital cost of the equipment per horse-power is less than a steam plant of equal duty. A great disadvantage is that not unfrequently the water supply is at the mercy of an outside electric system, which is liable to accident, often causing frequent interruption. In other words, the operation of the pumps is not, from the nature of things, entirely under the control of the water-works.

NOTES FROM UNITED STATES MACHINE SHOPS.

BY CHAS. S. GINGRICH, M.E.

IV.

Small Tool Manufacture.

The extensive use of large quantities of small tools, such as milling cutters, reamers, taps, etc., has developed such a great demand for these tools that their manufacture is now becoming quite an extensive, independent industry, there being several good-sized concerns who make the manufacture of small tools a specialty.

A large percentage of these small tools has spiral flutes, and one of the drawbacks to their economical manufacture has been the weakness of the Universal Miller, on which machine most of this work is done. There has been considerable improvement in this line lately, and in several of the largest small tool factories, I have seen this work done in about half the time that was formerly required.

The accompanying illustration shows one of the machines which, I believe, are giving the best results that have thus far been obtained in milling the flutes in large spiral milling cutters, in operation, and incidentally shows how such work is mounted on the No. 3 Universal Cincinnati Miller. This particular machine, it will be seen, is fitted with the geared-feed drive for which these machines are noted, and the work is held between centres of a spiral generating head which was especially designed for this heavy class of work. The material being milled is unannealed tool steel 5½-in. in diameter, with flutes at a 45 degree angle. The space which is milled between the flutes is ½-in. deep, and approximately ¾-in. wide at the top. This machine removes all this metal at a single cut, at a table travel of ¾-in. per minute. A final light finishing cut to smooth the groove is taken at a table travel of more than 1 1-16-in. per minute. This is considered by tool makers to be very fast work. The great difficulty in work of this kind is usually caused by the tendency of the machine to chatter, and it is only fair to state that in the job illustrated this tendency was entirely absent.

It is reported that the C.P.R. will build new stations at Calgary and Medicine Hat, N.W.T., and at Sudbury and Sturgeon Falls, Ont., this summer.

The I.C.R. will construct car repair shops at [illegible], C.B.

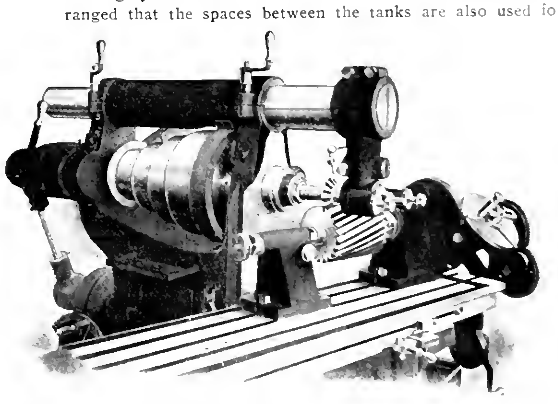
One thousand, nine hundred and seven miles of railway were built during the year ending June 30th last, or 39 miles more than the previous year; and 2,953 miles of siding, or an increase of 124 miles. The gross earnings of Canadian railways were $96,064,527, an increase of $12,398,024. Working expenses, $67,481,524, an increase of $10,137,932. Net earnings, $28,583,003, an increase of $2,260,092. 22,148,742 passengers were carried, being 1,468,768 more than in the previous year; and 47,373,417 tons of freight, an increase of 4,99[illegible]-890 tons. The electric railway receipts were $7,233,677, an increase of $747,239. Working expenses, $4,472,858, an increase of $670,003. Net earnings, $2,760,819, an increase of $277,-436. 17,981,410 more passengers, or a total of 155,[illegible]2,82, were carried, and the freight amounted to 371,286 tons, or an increase of 105,104 tons.

FIREPROOF GRAIN STORAGE ELEVATOR FOR THE CANADIAN NORTHERN RAILWAY, PORT ARTHUR, ONT.

FROM A PAPER READ BEFORE THE GENERAL SECTION OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS BY R. M. PRATT, C.E.

At the south-end of the town of Port Arthur, Ont., the Canadian head of navigation of Lake Superior and the Lake Superior terminus of the Canadian Northern Railway, and well out into the waters of Thunder Bay, stands a huge building, or rather two buildings about fifty feet apart. One of them is called the Working Elevator, and the other, the first of its kind in Canada or elsewhere, is the 2,130,580-bushel fireproof grain storage elevator built by the Barnett & Record Co., engineers and contractors, of Minneapolis, Minn., for Mackenzie & Mann Co., Limited, of Toronto, Ont. It is the latter building that is the subject of this paper.

The building consists of eighty circular tile grain tanks arranged in a cluster, as shown upon the drawings, and located 50 feet from and directly south of the Working Elevator. The tanks are each twenty-one feet outside diameter and eighty-three feet from the floor to the eaves, and so arranged that the spaces between the tanks are also used for



No. 3 Cincinnati Miller in operation.

storage of grain. All the walls of the interior tanks are eighty-five feet high. The capacity of the bins is as follows:

48 circular bins, each, 21,825 bushels	1,047,600 bus.
32 circular bins, each, 21,440 bushels	686,080 bus.
Total capacity	2,130,580 bus.

The tile bins rest upon a pile and concrete foundation, the whole surrounded by a revetment wall on three sides of the building and up to the working elevator to protect it from the wash of the waves, and the whole area enclosed within the revetment walls filled with earth to a height of about two feet above the mean level of the surface of the water in Lake Superior.

The piles were of pine, spruce and tamarac, 40 to 50 feet in length, 12 inches in diameter, three feet from the butt and eight inches at top inside of bark. They were driven to a solid bearing or until the penetrations did not exceed 1 inch to a blow of a 2,000-lb. hammer dropping 30 feet, or its equivalent if other weights of hammers were used, and so arranged that the load on the piles should not exceed 350 lbs. per square inch of bearing area under bark at cut off. The weight of hammers used was about 3,600 lbs., and the equivalent drop was made 20 feet after the piles were driven and cut off about 18 inches below water by a circular saw working in a traversing frame secured to the piles themselves to ensure their being cut off true and level; they were then capped with two courses of maple timber each four inches thick and fastened to the piles by ½ by 10-in. boat spikes. Directly upon this grillage, the concrete foundation walls were started. The concrete was composed of one part of Portland cement and three parts of clean, sharp sand and five parts clean gravel, ranging in size from that of a pea to that which would pass through a 2½ ring. The gravel was obtained from Isle Royal by dredging in about 15 feet of water and was a clean, flinty stone and very hard. Tests of the concrete from specimens therefrom showed broken that the stone broke instead of separating from the cement. The forms for the concrete coming below the water were made tight enough to ensure that the action of the waves did not wash out the cement. The concrete floors were constructed of the thickness shown in the drawings and re-inforced with metal rods of sufficient number and weight to carry the full loads imposed upon them without excessive strain, and a steel girder was placed each side spout openings to support the concentrated load. The walls of the tanks were constructed of a special hollow semi-porous tile and of the same quality as those used in the City of Minneapolis in the construction of the St. Anthony and Gt. Eastern elevators. The main wall tiles were 12-in. by 12-in. in size by 5-in. thick, alternately, with courses of channel tile 12-in. long by 3-in. deep and of the same thickness as the main wall tile. The main wall tile was laid with hollows running vertically, and the channel tile was laid horizontally. These tiles were of sound, hard, burnt, unglazed tile.

The exterior surface of the outer row of tanks was recovered with a facing tile 12-in. by 12-in., 2-in. thick, and was hard burnt, semi-glazed tile. The openings in upper end of main wall tile was covered with wire netting three meshes to the inch to permit of a full mortar bed to receive the channel tile. In the channel tile were placed steel bands, not less than two bands in each channel, the weight of these bands decreasing from bottom to the top. The facing tiles were securely anchored to each other and to the main wall tile in every fourth course where the joints come even with the inner tile with a piece of 3-in. by 4-in. galvanized wire netting four meshes to the inch, one anchor to each tile. All the tiles were laid in Portland cement mortar composed of three parts clean, sharp, screened sand well mixed and tempered with lime mortar. All mortar used to imbed the steel bands in the channel tile consisted of one part Portland cement and three parts sharp, screened sand. No lime was used in this mortar, it being made sufficiently thin to run in around the steel bands readily and fill all spaces between them. The tiles in cupola walls were of a thickness of 3-in. hollow tile, the outer courses glazed in the same manner as the facing tile in main walls, and were anchored together with wall chips and wire netting, and laid in Portland cement mortar same as for main building. All the roof surfaces, except the bridges and tunnels, were 12-in. by 18-in. by 3-in. hollow book tile resting upon the irons. These tiles were laid in a bed of Portland cement mortar on the flanges of the tee irons, and the upper surface pointed and smoothed with cement mortar to receive the gravel roof. The tile floors along belt galleries consisted of book tiles laid on tee and angle irons, the same as in the roof, the top surface being finished with a layer of Portland cement 1-in. thick. The floors in the walls between the belt galleries consisted of corrugated iron and concrete finished in the same manner as in the belt galleries.

The standard steel work in cupola of upper story of building consists of a skeleton steel frame work of standard sections arranged, as shown on plans, and put together on the work with suitable bolts, the pitch of bolt holes not exceeding 6-in. or sixteen times the thinnest outside plate or less than three diameters of the bolt.

The bridges for the fire belt conveyor, of which there is one to each conveyor, consisted of two steel trusses, as shown on plans, the floor of book tiles and concrete resting on tees and angles, the same as in upper belt conveyor galleries. The walls of the bridges were wire covered with No. 22, and the roof with No. 20 galvanized corrugated steel, and nailed to strips of wood bolted to the steel trusses. The bridges were provided with telescope joints at each end, so that the change in level of walls in working elevator would not have any injurious effect on either structure. There are two fire cut-off doors to each bridge and tunnel consisting of 2 by 4 studding covered with 1 by 6 D. & M. fencing closely fitted to all sides and around the belts, the sides next the working house being covered with tin, and the doors made to swing with a self-closing device. The cupola window frames were made of 2-in. pine with brick mould and inside casing fitted with 1⅝-in. check rail. All woodwork was covered with crimped galvanized iron. There are no windows inside next to the working elevator. The fifteen galvanized iron frame skylights in the roof were glazed with ¼-in. unpolished glass and the cornices and flashings were of No. 26 plain galvanized iron. The bin ladders were made of iron bars built into tile walls, one ladder to each, and every bin extending from top to bottom. There are also two fire-escape ladders, one on the south wall made of 2½ by ⅜-in. bars for the sides with ring of ⅝-in. round iron placed 16-in. centre to centre.

The entire main roof was covered with four-ply composition felt and gravel roofing, the tarred felt used being the Dominion brand manufactured by Lockerby & McComb, of Montreal. The exposed edges of each part were cemented down with hot pitch, and the entire surface covered with straight rim medium soft domestic coal tar roofing pitch 100 lbs. to the square. The gravel screened through a ¾-in. wire mesh screen one-fifth of a cubic yard to the square. Each and every bin coming over the tunnels or conveyors was provided with a cut-off spout with an extension of the same arranged to load the grain on to the belts, made of No. 14 steel. In the upper part of the building, no spouts are needed, except for the intermediate bins, and for these suitable spouts of No. 14 sheet steel were provided so as to take the grain from the tripper spouts.

There are five belt conveyors running from the working house out over the tanks. The width of the conveyor belts in the upper part is 36-in. supported by disc rolls 5 ft. 3 in. apart. The return belt carried on straight rollers 15 ft. 9 in. centre to centre. The shafts for these rolls were 1 3-16 with standard oscillating bearings attached to the wood supports resting on the steel frame work, and the wood support being covered with No. 26 plain sheet steel. The conveyor belts in the basement are 30-in. wide carried on straight rolls, similarly disposed as in upper belt conveyors. In the upper conveyor belt, there is one 2-pulley tripper for each belt. These trippers being provided with self-propelling devices, platforms, levers, etc., and provided with spouts discharging to either side so that the circular bins can be filled without any other spout than that provided on the tripper. These spouts are provided with cut-off gates and arranged to connect with the spouts from the intermediate bins already mentioned. All the trippers are carried on 16-lb. tee rails attached to the wood support mentioned for the roller bearings.

The shafting in working house required to work the belts is of steel, the couplings of the safety pattern standard flanged forced, bored true and forced on to the shafting under pressure of the collars for shafting, are provided with set screws protected by being counter-sunk and with protecting flange so as to make them flush on their outer circumference. The length of all bearings is three diameters of the shaft on which they are placed the friction clutches and pulleys of cast iron. The friction clutches were supplied by Messrs. Skillin & Richards, of Chicago. The conveyors' head pulleys were covered with four-ply rubber belting. The tension carriages were of approved design, and the rope drives

of manilla rope. The conveyor belts are four-ply rubber belting made of 30 oz. cotton duck pliable with hard surface stretched and spliced with Smith's patent No. 1 belt fastener. The conveyor belts are driven by light double leather belting, and the rope used in the various drives was tallow laid transmission ropes (Plymouth, 4 strand E.)

The building is lighted with 100 16 candle power, incandescent lamps, and provided with five extension cords for use in lighting lower part of bins. The building is also provided with signal bells and push buttons where required. The revetment was constructed according to the plans, except that the outside guard piles were 6 ft. centre to centre instead of 3 ft. The guard piles were of tamarac 40 to 45 ft. long, 3 ft. centres capped with 12-in. by 12-in. fir timber bolted to piles with bolts 1-in. diameter and 26-in. long, and two 6-in. by 12-in. fir stringers fastened with ½ by 12-in. boat spikes to outer row of piles, and two 8-in. by 12-in. fenders or wall streaks to outer or harbor side with ¾-in. screw bolts and washers counter sunk lead on outer side. The sheet piling is 8-in. by 12-in. fir timber, 36 feet long, built with tongue and groove of two-inch fir lumber the full width of the 8-in. sheet piles, and secured with 5-in. steel wire nails, 8-in. centre, so as to form a sand-tight bulkhead. A steam jet was used to assist the pile driver in getting these piles in place to avoid heavy pounding. The whole of the piling is being especially pointed. The structural steel work received in the shop one coat of boiled oil mixed with 10 per cent. of lamp black, and after erection one coat of lead and oil. All woodwork around windows received two coats of lead and oil, and all sash two coats red lead and oil.

The work was carried to a successful completion under great difficulties, such as the insufficiency of skilled workmen, the exposed position of the elevators, the long distances the greater part of the structural material had to be brought, retarding the progress of the work and causing a great part of the cement and other work to be done in severe, cold weather which rendered it necessary to heat the water and take the frost out of the sand and mortar before using. The contractors deserve great praise for the energy and courage displayed by them in overcoming all obstacles and giving to the North-West an additional storage for a part of its enormous wheat crop of 1902, and at a time when the lack of just such a storehouse would have been seriously felt by the North-West farmers. It has also had the effect of bringing Port Arthur to the front as one of the most important grain and freight transportation centres of Canada. The following data regarding the work may be of interest: First pile driven in elevator, 11th June, 1902; concrete begun, 20th August, 1902; tile laying, 26th September, 1902; first wheat received into bins, 19th January, 1903. Quantity of material in each eight feet in height of bin: 378 tiles, 12-in. by 12-in. by 5-in.; 378 channel tiles; 216 facing tiles, outside bins only; 336 facing tiles, outside corner bins only; 250 brick; 375 pieces wire netting, 12-in. by 4-in.; 12 pieces wire netting, 4-in. by 8-in.; 126 pieces wire netting, 12-in. by 1-in. for facing tile; 12 clips, 12-in. by 1½-in. by ⅛-in.; 6 crooked steps, 3-ft. 7-in. by ⅝-in. iron; 6 straight steps, 2-ft. 6-in. by ⅝-in iron; 4 tie rods, 11-ft. by ¾-in. Each thousand tiles took ¾ cubic yard grout 3 to 1. Each inside bin has four double channels 75 ft. long. Each outside bin has two double channels 75 ft. long. The hoops or bands in the channel tiles consist of 1½-in. by 3-16-in. and 1½-in by ⅛-in. steel bars, three complete hoops being used in the lower and two in the upper portion of the walls, thus varying the section to suit the pressure. Each bricklayer laid about 364 tiles per day of ten hours in the month of November. The capacity of each of the five top conveyor belts is 15,000 bushels per hour, and of each of the five lower belts 10,000 bushels per hour. The tiles were manufactured at Ottawa, Ill., by the National Fireproof Roofing Company. The steel bars for tank bands were furnished by the Carnegie Steel Company. The structural steel work by the Canadian Bridge Co., Walkerville, Ont. The machinery by Messrs. Skillin & Richards, Manufacturing Co., Chicago, Ill. The belting by the Gutta Percha and Rubber Co., Toronto, Ont. The roofing and sheet metal work was done by Irwin & Son, Hamilton, Ont. Most of the cement was furnished by the Owen Sound Co., some by the Rathbun, and a small quantity was imported from Chicago. The following is a copy of a report by H. E. Smith, consulting engin[illegible] Minneapolis, Minn., upon a test made to determine the [illegible] resisting properties of a section of hollow tile grain bin, [illegible] to correspond with the method used in the present elevat[illegible]

In order to make the test as practical as possible, [illegible] four weeks ago a section of wall was constructed, the details of which are shown in the accompanying blue print, [illegible] correspond to that which would be constructed for a 45-[illegible] diameter grain elevator storage bin. Against this was built an oven or furnace, in which by means of fire the necessary heat could be brought to bear upon the outer wall of the experimental bin.

Time p.m.	Temperature deg. Fahr.
3.30	500
3.37	600
3.38	700
3.38½	800
3.39	900
3.39½	1000
3.40	1100
3.41	1200
3.42	1250
3.44	1270
3.46	1200
3.50	1150
3.51	1200
3.52	1250
3.54	1300
3.55	1330
3.56	1350
3.57	1365
3.59	1390
3.59½	1400
4.01	1440
4.02	1470
4.03	1500
4.04	1540
4.05	1570
4.06	1620
4.07	1700
4.09	1800
4.10	1900
4.10½	1950
4.11	2000

This table shows the time and corresponding temperature during the next 41 minutes of the test.

As the limit of the pyrometer was 2,000 degrees, the instrument had to be removed when this temperature was reached. The actual temperature of the furnace was, no doubt, considerably above 2,000* degrees at the maximum.

*This is the temperature at which cast iron melts.

At the maximum heat a solid body of flame rose to a height of about two feet above the tile chimneys, and flame was always visible during the greater part of the test.

The snow that was packed against the exposed iron band on the inside of the wall began to show signs of melting at 4.00 o'clock, when the temperature of 1,800 degrees had been reached, and, at the end of the test, a small amount of snow still remained at this point. The patches of snow on the interior of the wall showed no signs of melting at the end of the test.

A pyrometer tube was inserted near the top of the furnace and about six inches from the portion of the wall to be tested and directly in the path of the heated flame and gases which impinged on the wall. The pyrometer, when thus located, was believed to show the temperature to which the wall was subjected On the date of the test the temperature of the outside air was fifteen degrees above zero. On the inside of the wall at the location of the exposed iron band in the wall, some snow was packed against the band and a number of patches of snow placed upon the tile wall itself, in order to observe the effect of the transmitted heat through the wall. A fire was started upon the grate of the furnace at 2.15 o'clock, and the temperature of the furnace rapidly rose to 800 degrees Fahr. After the fire had burned itself out sufficiently, the bin wall of the furnace was carefully examined and no trace of a check or crack could be found. In view of the fact that the fire had been continued for two and one-half hours, the heat to which the wall was subjected correspond, in my opinion, closely to that which would be produced by the burning of a wooden structure built against the side of an actual grain bin of this description. The results of this test seem to indicate that this kind of construction for grain storage would withstand any ordinary external heat due to adjacent fires, and would at the same time also prevent an undue transmission of heat to the grain stored within.

Respectfully submitted,

HARRY E. SMITH,

Consulting Engineer.

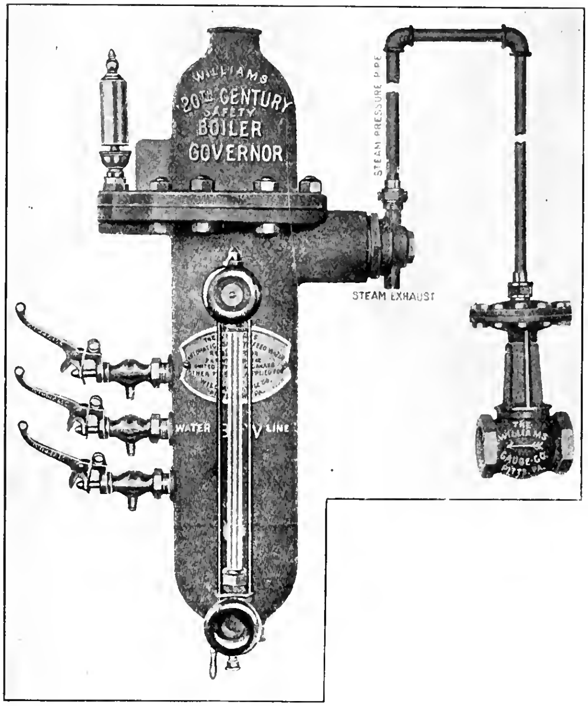
The cost of the building, including revetment, everything complete, except the earth filling around and under foundadations was $397,095.80.

The superintendent of construction for the contractors was F. R. McQueen, and their chief engineer was E. D. Mayo. The writer is indebted to the latter for the photos. of the working drawings used to illustrate this paper.

The superintendent for the company was R, Dickson, and the writer was engineer in charge of the work.

FEED WATER REGULATOR.

The accompanying cut shows the Williams Automatic safety feed water regulator for which Darling Bros., Montreal, have been appointed Canadian agents. This feed water



regulator is applied to steam boilers for the economical production of dry steam. Its aim is to increase the efficiency of steam boilers and engines, by automatically controlling the water at the proper fixed point, preserving the exact amount of water continuously in exact proportion to the heating surface and the capacity of the boiler furnaces, thus constantly producing the limit of the boiler's highest efficiency. It is constructed to give an alarm for high or low water in case of accident, and the makers assure the engineer that his only labor is to start the pumps and blow out the sediment in the regulator once or twice a day. The circulars issued with the regulator contain letters testifying to a saving of 6 to 15 per cent. in fuel, enough in some cases, it is claimed, to save the cost of the machine several times in a year. Particulars as to its mode of action can be had from Darling Bros., Reliance Works, Montreal.

QUEBEC'S MINERAL OUTPUT LAST YEAR.

The following are the quantities in tons of 2,000 lbs. and the values at the shipping point, of the minerals produced in Quebec during 1903, as from returns prepared by J. Obalski, Inspector of Mines, for the province:

	Tons.	Value.
Magnetic and titanic iron	100	$ 300
Bog ore	10,742	34,984
Chrome ore	3,037	45,555
Copper ore	25,000	125,000
Galena (approximate returns not complete; returns not received).		
Asbestos (value approximate)	31,671	900,000
Asbestic	10,581	13,242
Mica (thum trimmed; returns not complete).		
Ochre (calcined)	1,746	20,440
Graphite	....	....
Feldspar	20	37
Sulphate of baryte	440	2,640
Phosphate	1,187	8,214
Gold (ounces)	....	600
Slate quarries	5,510	22,040
Flag stones (square yards)	3,000	2,550
Cement (barrels)	40,000	66,000
Granite (The same as last year).		
Lime (barrel). (The same as last year).		
Bricks. (The same as last year).		
Stones. (The same as last year).		
Pig iron produced	9,635 ¾	$230,639 46

—The Canadian Rubber Co., of Montreal, recently remodelled their power plant and found that the tall brick chimney, 110 feet high, would not give the proper amount of draft necessary in connection with the four new Stirling boilers they were to install. Mechanical draft was necessary and for this purpose a large Sturtevant steel plate fan driven by a Sturtevant horizontal engine was installed, and now the proper amount of draft is easily attained and regulated at will regardless of the weather conditions. This is another illustration of the advantage of mechanical draft in connection with the remodelling of old boiler plants.

The application of the London, Alymer, and North Shore Electric Railway Co. to bond their road at $25,000 per mile has been granted by the Ontario Legislature. The cost of the road is estimated at $1,100,000.

The Kingston Locomotive Works has closed contracts for ten engines for the Canadian Pacific and twenty-five for the Intercolonial Railway.

The Canadian Engineer

VOL. XI.—NO. 5. TORONTO AND MONTREAL, MAY, 1904. PRICE [illegible] / $1.00 PER YEAR

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY, MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada, Great Britain and the United States, $1.00 per year, foreign, 6s. Advertising rates on application.

OFFICES—18 Court St. Toronto; and Fraser Building, Montreal.
Toronto Telephone, Main 4310. **Montreal Telephone,** Main 2589.
BIGGAR-SAMUEL, LIMITED, Publishers,

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 15th of the preceding month or if proof is desired, 4 days earlier.

CONTENTS OF THIS NUMBER:

THE TORONTO FIRE AND ITS LESSONS.

The night of April 19th, 1904, will long be remembered for the most disastrous fire from which Toronto ever suffered, a conflagration which far exceeds that which has ever visited any Canadian city in the value of property destroyed. By it a large part of the wholesale district of the city was wiped out. The fire broke out at 8 o'clock in the evening, and before it was got under control, in about 9 hours, 14 acres had been burned over and property to the value of nearly $15,000,000 destroyed, with about $10,000,000 of insurance. The fire had its useful lessons, to which all concerned would do well to take heed.

As to the origin of the fire, it is attributed to electric wires. Formerly all fires, the origin of which was obscure, were attributed to incendiarism. Now the electric wire has to bear the blame. Whether it was the cause of the Toronto conflagration or not will probably never be known. There is no doubt that electricity is a prolific cause of fires, and that many such disasters may be attributed to defective and unskilful wiring. There is danger also from short circuiting, the gnawing of insulating material by rats, and other causes which appear to be almost beyond control. It behooves property owners, electric contractors, insurance companies, and all others who have to do with such matters to see that the utmost care is exercised in installing electrical apparatus, in order that the danger may be reduced to the minimum.

Though Toronto has an efficient fire brigade, which is fairly well equipped, it is evident that something is still wanting if they are to cope successfully with an extensive fire. After the Baltimore conflagration, which the Toronto one resembles in many respects, some of the business and insurance men who visited the scene were impressed with the desirability of having, in cities with a water front, a water service for fire purposes alone, and entirely separate from the ordinary waterworks. Had Toronto possessed such there is little doubt much property could have been saved on the night of the 19th. One of the chief difficulties the fire brigade had to contend with was poor pressure, and it stands to reason that if a large number of streams are being drawn from the mains the pressure must be greatly reduced. The proposition is that fire mains should be laid in the business part, with stationary steam or gasoline pumping engines on the water front, to be used for fire purposes only. The city council has asked for a report on the subject from the chief of the fire brigade, and there is little doubt what it will be, and that such a system will be installed in Toronto before long, as it has been in some cities in the United States.

Another suggestion is that all high buildings should be equipped with stand pipes and hose on every flat. With high buildings catching fire at the top, as most of those in the Toronto fire did, it is almost impossible to reach the fire with ordinary hose. Water towers are of some service, but even they fail to accomplish their object after buildings reach a certain height; and even then, as is the case with hose, the stream is scattered in the face of a high wind, such as prevailed in the Toronto fire. The automatic sprinkling system serves a useful purpose, and it was the means of saving the Kilgour factory and preventing the spread of the fire to Yonge Street. We expect to see this system more extensively introduced as a result of this lesson.

A fire tug would be a good thing to have in Toronto harbor. This was evident at the time of the fires at the west end of the island last year, and probably some of the property along the Esplanade which was burned in the recent fire might have been saved by such an appliance.

A dead wall is sometimes an efficient protection. The J. D. Ivey Co., at whose premises the fire stopped on Wellington Street West, attributed their escape largely to the fact that there were no window or door openings on the east side of their building. It must be remembered, however, that the direction of the wind was away from them. Where there are openings iron shutters are a great protection. They are of no use, however, unless they are in place and closed, and this was the case with some buildings at the Toronto fire.

Iron window frames, with iron sash, glazed with wire glass, should be more employed in large buildings. Wire

glass has not come into general use, and is not looked upon with favor by many. Ordinary glass may answer where iron shutters are used.

A. A. Allan & Co., wholesale furriers, saved a large quantity of valuable goods by storing them in what are usually coal areas under the sidewalk. These had been converted into fire-proof vaults by means of iron doors. The less valuable coal is likely to give way to the more valuable goods in such places in the future.

Many of the burnt-out firms lost their books and papers, which were supposed to be safe from fire in their vaults. This is, of course, the result of faulty construction, for stone, brick and iron vaults are fire-proof under almost any circumstances, if proper precautions are taken in their construction. The ordinary fire-proof safe seems to have done its work well in the midst of what was a very hot fire.

As has been demonstrated before, iron construction of buildings does not prevent their destruction by fire. Instead of being consumed the material becomes warped and twisted out of all shape. Only when fire-proofed by the use of terra cotta or concrete will iron stand the intense heat without injury.

On the question of general construction the remarks of Foster Warner, architect of the Granite Building, Rochester, may be quoted. He says: "I believe that the only fire-proof building is the one that has been constructed of material that has been created by fire. In other words, brick and terra cotta are made by fire. Consequently it stands to reason that these materials will better stand an extreme degree of heat than stone or concrete, which have never been subjected to a high temperature." The cement men dispute this opinion, and claim that concrete should be included among efficient fire-proof materials.

It would be a great protection if elevator shafts and stairways were inclosed in fire-proof walls. How often do we hear of flames running up elevator shafts, which serve as great draft tubes. The Toronto fire spread in the building where it broke out in this manner.

The Toronto fire spread with remarkable rapidity. Notwithstanding the substantial character of most of the buildings in the fire-swept area the flames leaped from one to another with irresistible fury, being driven along by a high north-west wind, which at times approached almost to the velocity of a gale. Almost nothing was saved. Buildings, machinery, stocks, all were swept away. But the sufferers are facing the situation bravely. Under the direction of the city engineer the walls of the burned buildings are being blown down with dynamite, and preparations for rebuilding are going on rapidly. A better and more substantial city will rise from the ruins of Toronto's great fire.

ELECTRICAL SMELTING.

If Canadians as a nation had the education in chemistry which the Germans have they would in a single generation lead the world in electro-chemical industries. Canada has the water powers, thousands of which are running to waste as yet. Combine this great natural asset with the German aptitude for chemistry, and industrial miracles would be wrought all over the country. Cheap water power brings within the range of commercial success hundreds of products which without such cheap power would forever remain curiosities of the laboratory or the lecture-room. A glimpse of the industries now carried on at Niagara Falls in the electro-chemical field opens up a vista of enormous possibilities wherever large water powers exist with raw materials near at hand. The large and steady increase in the production of carbide of calcium for the manufacture of acetylene gas is one example among others of the successful developments that have already taken place in Canada in this branch of science as applied to industry.

The smelting of ores by electricity is another application of the cheap electrical power which this country possesses in unique abundance; and the foresight which prompted the Dominion Government to send a commission to Europe to investigate the electro-thermic processes in development there is likely soon to be demonstrated in a practical way. The commission, consisting of Dr. Haanel, of the Geological Survey, C. E. Brown, electrical engineer, and a secretary were joined in England by Prof. F. W. Harbord, of Cooper's Hill, Surrey, metallurgist to the Government of India, and proceeded to Sweden, where the electric smelting of iron is carried out upon a commercial scale. They also visited Germany and France, where smelting by electricity is carried on. The experiments at Livet, in the Pyrennes, were considered the most important. A sample lot of ninety tons of Spanish ore was put through for the benefit of the Canadian Commissioners, who brought away samples of the pig iron, which was smelted, it is said, at a cost of $8 a ton. It was demonstrated here that both pig iron and steel could be made by the electrical process alone. The commission will report on the cost of these processes, and upon this will depend the applicability of the method to those portions of Canada where coal is not to be had cheaply for smelting. Dr. Stansfield, of Montreal, in a recent lecture before the Canadian Society of Civil Engineers, expressed his doubts as to the commercial advantages of the processes he had examined, except in cases where water power was very cheap, and where both the raw material and the market for the finished product were close at hand. Dr. Haanel, however, appears to be much more hopeful of the processes he investigated, and if the electrician's report is equally favorable, we may soon see in various parts of Canada the reduction of other metals besides iron by electricity.

—At the meeting in Montreal, last month, of the wire nail manufacturers of Canada to consider the question of renewing their contracts with the United States Steel Trust for wire rod for the year's supply, several features of interest developed. One was that the Dominion Iron and Steel Co. expected to be in a position to manufacture steel rods within the month, and the American Steel and Wire Co., one of the branches of the United States Steel Trust, had not, it was claimed, lived up to their agreement during the past year, as they had not sold rods as cheaply to Canadians as they could be imported by Canadian firms from Great Britain, Germany or Sweden. It is claimed that the difference in price was between $4 and $5 per ton. The United States Company were anxious to have their agreement renewed at this meeting, and succeeded in obtaining contracts from some of the Canadian manufacturers for six to twelve months' terms. It is said that one of the arguments used was a threat to enter the Canadian market with manufactured wire nails and compete with the Canadian manufacturer if he did not agree to the terms they imposed for the purchase of wire rod. Another meeting was held later in Toronto; and it is understood that one prominent manufacturer in the East refused to be coerced, and that his example would

be followed by some Western manufacturers, who, in that case, will have to look to the Dominion Iron and Steel Co. or to Europe for their supplies, and face probable competition from the United States. Some of the other firms, however, succumbed to the threat, and have placed their orders for the year. The competition referred to will, however, hardly materialize, as the duty on wire nails is 60c. per 100 lbs., with a further duty on the kegs or boxes, and the United States Steel Trust in order to secure trade would be obliged to sell the manufactured article as low, if not lower, than the price charged Canadian manufacturers for the rods. This agreement between Canadian wire nail manufacturers on the one hand and the American Steel and Wire Co. on the other, has been in force since 1899, with the exception of 1900, and included all wire nail manufacturers in Canada. The American Steel and Wire Co., in return for these Canadian companies purchasing wire rod supplies from the Trust kept their manufactured product out of the Canadian market, on the same plan, if not by the identical means, taken by the makers of shovels to divide the Canadian and United States markets between them, as far as such monopolies are able to do. In both cases the monopoly may end, as we learn that a new company is now quietly installing a plant to make shovels in Canada on a scale which will certainly affect the market price of those commodities.

—A communication in this issue corrects an error into which we fell last month as to the position of the American Machinist on the question of metric weights and measures. We were informed by a United States manufacturer of machine tools—who, while opposed to the introduction of the system on the ground of cost, yet believes it inevitable—that Mr. Miller was personally a believer in the advantages of the metric system. Mr. Miller does not state his own personal convictions, but if his friend is wrong, the misconception probably arises from the fact, mentioned in the letter, that nearly all who have written in the American Machinist are advocates of the introduction of metric weights and measures. To those who are regular readers of our able contemporary, and have marked the high average of intelligence and practical knowledge of machinery shown by its contributors and correspondents, this fact alone will bring conviction that the metric system is bound to be adopted by the Anglo-Saxon world. The chief difficulty in the engineering trades is the fear that the change will be very costly. We believe this cost is much over-estimated.

THE METRIC SYSTEM IN PRACTICE.

Editor, Canadian Engineer:—

Sir,—Much discussion of a speculative nature has been indulged in, in regard to the Metric System, as to whether its application in commerce would, or would not, be fraught with much benefit.

Unquestionably the change from any one system of measurement, to any other, will occasion temporary inconvenience, irrespective of whether the system changed to is either better or worse than that changed from. Experience has shown that the public adheres tenaciously to a practice once adopted, and a long continuance of almost any practice creates a bias, and will more or less mask the ability to see an innovation in its true relation to the end desired—the knowledge of what is—being much more complete, than the knowledge of what might be.

Much favor is lavished upon the so-called duo-decimal system, because 12 can be divided by 2, 3, 4, and 6, the dividend being a whole number in each case. The late Herbert Spencer urged th[illegible] point, and [illegible] much moment, but the decimal notation offer[illegible] advantage in that it is easy to work [illegible] tical problems mentally by th[illegible] duction of 12's would [illegible] much increase the difficulty.

Moreover, the commercial [illegible] the percentage method of expressing [illegible] values, that in the nature of things [illegible] to combine a centessimal system [illegible] and volumetric measurements.

As one who has used the Metric System [illegible] side with our feet and inches, pounds, and [illegible] phatically favor the Metric System, and I can [illegible] sert that any one who essays to become as [illegible] system as they have been with the duodecimal [illegible] want to return to the latter.

No analysts use septems, minims, and grains now; even when results must be expressed per gallon, the so-called "miniature gallon" is used being 70 cubic centimeters, which volume of water contains as many milligrams as there are grains in a gallon, and so by transposition of terms each milligram counts as one grain per gallon; this miniature gallon is largely used in water analysis. Assayers appreciating the ease of the Metric Sytem have adopted a weight known as the "assay ton" (approximately 35.8 grams), which contains as many milligrams as a ton does ounces, and so one milligram pound represents 1 oz. per ton of precious metal. Another instance of the convenience of the Metric System is afforded when the barometer is used for ascertaining heights, where a decrease of one millimeter represents an ascent of 10 meters, or, as one can see at a glance, the ascent is ten thousand times the diminution in the barometric column; this is by no means so easy to perceive when the statements are made in feet and inches, e.g., a reduction of the column by one-tenth inch equals an ascent of about 87 feet. Again, in computing the weight of liquids from the measurements of the containing tanks, the superiority of the Metric System becomes apparent; up to the point where the cubical contents are ascertained there is not much difference, but having obtained the number of cubic feet we must now multiply by 6.23 for gallonage, and 62.3 for pounds; whereas, having ascertained the number of cubic decimeters you may either call it kilos for weight or litres for volume; this point saves an enormous amount of work and time where much liquid measurement is necessary, as in breweries, distilleries, soap works, and chemical works generally.

It is unfortunate, but not inconvenient, that the meter exceeds the 10-millionth part of the meridional arc of the earth (by one part in 6,400 or .0155 per cent., as stated by Sir John Herschel), which it was intended to be, nevertheless this does not impair its usefulness. In conclusion, I would say to those who oppose the Metric System, use it till you are thoroughly familiar with it, and you will fall in love with it.

Yours truly,

HARRY SPURRIER.

Davenport, April 23rd, 1904.

THE METRIC SYSTEM.

Editor, Canadian Engineer:—

Sir,—As some further evidences of the extended desire, through all classes in this country, for the adoption of the Metric Weights and Measures, I may inform you that the petition—of which a copy is attached—is being signed by all trade unions, by all the chambers of commerce, by all the teachers' associations, by all the retail trade societies, and by most of the town and county councils, hundreds of thousands of individuals, merchants, school-masters, ministers of religion, shopkeepers and retailers, manufacturers, engineers and workmen.

In all, several millions of persons will be represented by the signatures of officials of the various organizations.

Moreover, there are 315 M.P.'s pledged to vote for our Metric Bill, and it is certain that these promises could not

have been secured had the Parliamentary representatives not felt that their constituents were anxious for the change.

I am, Sir, your obedient servant,

E. JOHNSON,

Sec., Decimal Association, Cannon St., London, Eng.

Extracts from the petition referred to: That in the opinion of your petitioners the adoption of the Metric Weights and Measures by this country is highly necessary: 1st. Because it has already been adopted by nearly all the civilized countries. 2nd. Because it would materially assist education by facilitating the teaching of arithmetic, and setting free a considerable amount of time which would be devoted to more useful subjects than the learning and practising of our complicated and confused Tables of Weights and Measures. 3rd. Because, as our Consuls frequently reiterate, we lose trade in consequence of our Weights and Measures not being understood in other countries, and because the adoption of the Metric Weights and Measures would obviate the present necessity for manufacturing on one basis for export trade and on another for home trade. 4th. Because the colonies desire the change, but feel that the lead must, on account of intercolonial trade, be taken by the Mother Country. 5th. Because it would lead to the abolition of a large number of anomalous, customary, or local, but illegal, Weights and Measures, still largely used in various parts of the country. These irregular Weights and Measures are chiefly objectionable because they give facilities to dishonest traders to take advantage of purchasers who are not acquainted with them.

That numerous demonstrations of the desire for the change have been made by resolutions and petitions of public bodies, institutions, chambers of commerce, trades unions, retail trade organizations, manufacturers, engineers, and teachers.

That a Select Committee of the House of Commons in 1895 reported in favor of the compulsory adoption of the Metric Weights and Measures within two years.

That your petitioners are much disappointed that, although eight years have elapsed since then, no steps have been taken to give effect to this recommendation of the committee.

That by reason of the fierce competition for foreign trade, the need for the change is even more serious now than in 1895.

That there are indications that the Metric Weights and Measures will before long be adopted by the United States, one of the main arguments likely to influence that result being the facility it would give for successful competition with this country in trading with countries using the Metric System, especially in the Republic of South America.

That the Colonial Premiers at the Coronation Conference resolved: "That it is advisable to adopt the Metric System of Weights and Measures for use within the Empire, and the Prime Ministers urge the Governments represented at this Conference to give consideration to its early adoption."

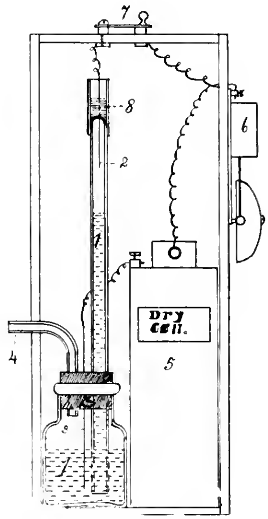
A NEW VACUUM GAUGE AND ALARM.

Harry G. Spurrier, of Davenport, Toronto, has invented a vacuum gauge and alarm, for which a patent has been issued.

The instrument was devised primarily to meet the necessities of vacuum pan practice, where even small variations of vacuity seriously affect industrial results. The instrument consists of a rather short mercury column (1) which by its variations of altitude will make or break electrical contact with a bell and battery circuit, resulting in an audible as well as visible announcement to the engineer.

A small bottle or reservoir containing mercury is tightly fitted with a rubber stopper (S) through which passes the tube containing the mercury column, and bearing a platinum wire fused through its upper end. The lower end of this tube passes nearly to the bottom of the reservoir, and is well immersed in the mercury.

Through the rubber stopper also passes a bent tube (4) terminating immediately beneath the stopper, and also a wire (3) which passes into the metal in the reservoir. The necessary bell and battery wiring completes the arrangement. In practice the connection is made by stout India rubber tube between the bent glass tube and a small metal tube tapped into any convenient portion of the pipe or pan to be exhausted. As the vacuity increases in the condenser-chamber or pan, the mercury in the upright tube descends to a point correspondingly low. At a predetermined point, say 25 inches, or 635 millimeters of vacuum, the mercury in the column falls below the lower extremity of the platinum wire and the electrical circuit is broken at this point,—but, should the vacuum fall below 25 inches, or 635 millimeters, the mercury will rise, touch the wire, and the bell will ring, and continue ringing until the switch (7) is opened or the vacuum increases.



Vacuum Gauge and Alarm.

1—Mercury. 2—Plat Wire. 3—Copper Wire. 4—Tube to Vacuum Pipe. 5—Battery. 6—Bell. 7—Switch. 8—Mercury Cup.

The obvious use of such an alarm in a condensing plant scarcely needs comment, as the engineer is at once warned of approaching danger, and the cost of the instrument would be more than repaid in a single instance when flooded cylinders were avoided. The instrument may be piped up by ¼-inch pipe to any desired point, or the bell alone may be wired to the chief's office.

The alarm is also an absolute check for accuracy to ordinary spring gauges. By measuring the column of mercury from the level in the reservoir to top of column—the "deficiency," or how far short of perfect vacuity the realized vacuum falls, may at once be ascertained, this measurement being absolute, which is not the case when the vacuum "realized" is gauged in the ordinary way, because this implies a constant barometer which we do not actually have. A model as the cut has been in actual operation for two years, and on dozens of occasions has rung out a valuable warning, and has never failed in a single instance to report itself at the right moment.

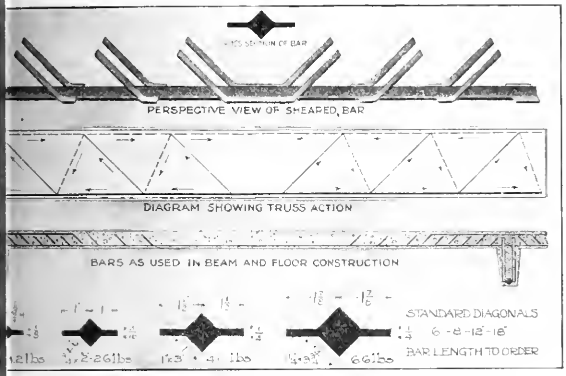
This instrument will at once appeal to all who operate condensers, whether attached to engine or pan systems. Its use, for example, on the big engine of the Street Railway power house in Montreal would have saved the disastrous accident which happened there two or three years ago.

—Two spans of the C.P.R. bridge, near Saskatoon, have been washed away by the high water in the South Saskatchewan.

—The E. S. Harrison Co., Winnipeg, have been awarded the contract for the machinery in the new power house for Regina, N.W.T., to be constructed from plans by John Galt, C.E., of Toronto.

THE KAHN TRUSSED BAR IN REINFORCED CONCRETE.

As thoughtful architects and engineers are giving the subject of reinforced concrete a great deal of attention, a description of the Kahn system of reinforced concrete will be of interest. Julius Kahn, a civil engineer of Detroit, Michigan, realizing that the forms of reinforcement used did not provide for all possible loads, has invented a trussed bar, patents for which have been turned over to the Trussed Concrete Steel Company, of Detroit, Michigan. The Kahn trussed bar consists of a half truss struck up from a single rolled section, providing the tensional members of a truss. Concrete is an excellent material for compression, but is comparatively weak in tension. When the Kahn bar is imbedded in a mass of concrete, forming an independent, self-contained beam or truss, the concrete supplies the missing compression members of the truss. A beam when built in this manner, when tested to destruction, invariably fails at the point of greatest bending moment by pulling in two the



steel reinforcement which is imbedded within the concrete. The Kahn trussed bar, not only provides horizontal reinforcement, but also vertical reinforcement, which European engineers have found so necessary to provide for shear at the ends of the beams. These engineers endeavored to overcome the shearing strains by using U-shaped stirrups of iron around the horizontal rods, which have been used largely for reinforcement heretofore. The advantage of the Kahn trussed bar lies in the fact that the sheared up members are rigidly attached to the main horizontal bar, being, in fact, a part of the bar, and they therefore carry all strains directly into the main tensional member. It has been found by tests where twisted or deformed rods were used for reinforcement, that when tested to destruction, they failed by shear either at the ends or along the main horizontal member, and the concrete would open up at an angle of about 45 per cent. with the horizontal. The inclined members of the Kahn bar cross these lines of rupture at practically a right angle, and they therefore hold the material together. Another advantage claimed for this bar is that at the centre of the beam, where bending moment is greatest, the full cross-section is left unsheared, whereas, at the ends where maximum shear occurs, and bending moment is the least, the members are struck up to provide for shearing stresses.

An illustration of this form of construction can be seen in Toronto, where the roof of a fur vault for the Gillespie Estate has been designed in accordance with the Kahn system by Gordon & Helliwell, architects, and is now under construction. The Trussed Concrete Steel Co. has offices in the leading cities in the United States, and has now extended its business to Canada, having appointed A. J. Stevens, C.E., Canada Permanent Bldg., Toronto, as general agent for the Dominion.

* * *

The Eugene F. Phillips Co. will build their large new factory at St. Louis du Mile End, a suburb of Montreal.

THE TORONTO FIRE.

The following industries were burned out in the great Toronto fire of April 19th: M. McLaughlin & Co. Dominion Flour Mill, Toronto Coffee and Spice Mills, Henderson Roller Bearing Mfg. Co., Dominion Fence Co., A. Dunlop, elevator manufacturer, Pugsley, Dingman & Co., soap and blue manufacturers, Eckardt Casket and Eckardt Silver Plate Co., Wm. Jessop & Sons, dealers in steel; W. A. Rogers, Limited, silver plate manufacturers. The wholesale stationers, who suffered heavily, nearly all carried on manufacturing or printing on their premises and many of the wholesale dry goods dealers had manufacturing departments.

When it was seen that the fire would reach large dimensions, outside aid was asked by telephone, and Hamilton, Brantford, London, Peterboro and Buffalo sent detachments of their fire brigades, which rendered efficient help.

* * *

R. G. Black, chief electrical engineer Toronto Electric Light Company, gave an interesting talk to the Canadian Asssociation of Stationary Engineers, in the Engineers' Hall, Toronto, April 20th, on "Alternating Current and How to Handle It."

* * *

—E. H. McHenry, chief engineer of the Canadian Pacific Railway, has resigned the position which he assumed two years ago, succeeding P. A. Peterson. For some time he has not been in the best of health. The name of a prominent engineer, understood to be W. F. Fye, assistant chief engineer of the C.P.R., is mentioned as Mr. McHenry's successor, but nothing has been decided. Mr. McHenry was at one time receiver of the Northern Pacific, and is reported to be a man of means. It is rumoured that he will join the staff of the Grand Trunk Pacific.

* * *

The first of twenty new locomotives, which are being built for the C.P.R. at the Saxon Engine Works, Chemnitz, Germany, is being tested at Montreal. They are made to a design furnished by the C.P.R. The diameter of the cylinders is 23 inches; diameter of driving wheels, 63 inches; total wheel base, 25 feet 2 inches; weight, 168,335 pounds; water capacity, 5,000 gallons; coal, 10 tons, weight of tender, 127,000 pounds; total wheel base of engine and tender, 53 feet; total weight of engine and tender, 205,355 pounds. They are ten-wheeler compound, and will haul large trains with freight cars of sixty tons each, the solution, in fact, of the problem, how to make profits at present rates. They will cost about $20,000 each. While twenty will complete this particular order, the C.P.R. really need something like one hundred and fifty new locomotives, which are being supplied as fast as the local shops and foreign firms can turn them out. As far as tested the German engine gives satisfaction.

* * *

NEW CATALOGUES.

Copies of the following catalogues and bulletins received may be had on writing to any of the firms named, mentioning The Canadian Engineer:

The Westinghouse Electrical Manufacturing Co., Pittsburg, Pa., "Westinghouse Auxiliary Apparatus for Railway Equipments"; "Electric Locomotives for Surface Haulage"; "Westinghouse Automobile Charging Outfits"; "Type Motors"; and "Westinghouse No. 91 Single-Phase Railway Motor and Car Equipment."

The Brown & Sharpe Manufacturing Co., Providence, R.I.: Milling and grinding machines, automatic gear cutting machines, screw machines, cutters, accurate test-tools, and machinists' tools, gauges, etc.

The Trussed Concrete Steel Co., Detroit, Mich.: "The Kahn System of Reinforced Concrete."

The Bullock Electric Manufacturing Co., Cincinnati, Ohio: "Methods of Speed Control," a treatise on the electrical control of speeds.

J. H. Williams & Co., Brooklyn, N.Y.: Automobile and general forgings in iron, steel, copper, bronze and aluminum, drop-forged wrenches and "Vulcan" patent drop-forged chain pipe wrenches.

Arthur Koppel, New York: "Narrow Gauge Railway Materials." (Supplement to Catalogue No. 77.)

The Hisey-Wolf Machine Co., Cincinnati, Ohio: "The Hisey Portable Electrically-driven Grinders and Drills."

The Keystone Manufacturing Co., Buffalo, N.Y.: Machinists' tools, ratchets, wrenches, steel sockets, centre punches, etc.

The Railway and Electric Equipment Co., Buffalo, N.Y.: "List No. 2": electrical machinery and railway equipment.

The Joseph Dixon Crucible Co., Jersey City, N.J.: Graphite pipe joint compound.

The American Steam Packing Co., Boston, Mass.: "American" steam packings and beltings.

The Canada Foundry Co., Toronto: The "Beaver Posthole Digger."

North Bros. Manufacturing Co., Philadelphia: "Yankee Tools."

The Moran Flexible Steam Joint Co., Louisville, Ky.: "The Moran Flexible Joint."

The Knowles Steam Pump Works, New York: "Pumping Machinery for Beet Sugar Factories."

The Standard Pressed Steel Co., Philadelphia: "The American Pioneer Pressed Steel Shaft Hanger."

The Laidlaw-Dunn-Gordon Co., Cincinnati, Ohio: "The Improved Cincinnati Air Compressor."

The Pittsburg Meter Co., East Pittsburg, Pa.: "The Keystone Water Meter."

The France Packing Co., Tacony, Philadelphia: Steam stopper packings.

The National Electric Co., Milwaukee, U.S.A.: Catalogue No. 60, "Alternators."

Thos. H. Dallett Co., Philadelphia: Pneumatic tools.

The Colburn Machine Tool Co., Franklin, Pa.: The New Colburn Universal Saw-table.

The Geo. White & Sons Co., London, Ont.: Threshers, traction engines, locomotive boilers, stationary engines and boilers, steam saw mills, etc.

The Jenckes Machine Co., Sherbrooke, Que.: "The Farrel Patent Crusher."

Fairbanks, Morse & Co., New York and Chicago: Hoists and mining machinery, operated on gasoline, naphtha, distillate, kerosene and crude oil.

W. R. Perrin & Co., Toronto: Catalogue No. 8: machinery for abattoirs and packing houses.

The Crandall Packing Co., Palmyra, N.Y.: Steam, ammonia and hydraulic packings.

Johnson & Phillips, London, Eng.: Arc lamps, brackets, electric fans, etc.

The Mason Regulator Co., 156 Sumner Street, Boston, Mass.: "The Mason Pump Governor."

National Electric Co., Milwaukee, Wis.; Direct Current Generators and Motors.

Kellogg Switchboard and Supply Co., Chicago; Magneto Switchboards.

Westinghouse Machine Co., East Pittsburg, Pa.; Westinghouse-Parsons Steam Turbine.

A. Leschen & Sons Rope Co., St. Louis, Mo.; Long Distance Transportation of Ores by Aerial Wire Rope Tramways.

Sheldon & Sheldon, Galt, Ont. Steel Plate Planing Mill Exhausters; also Friends—Heating and Ventilating Systems.

The Garvin Machine Co., New York; Metal Working Machine Tools.

Joseph Dixon Crucible Co., Jersey City, N.J.; Proper Care of Driving Chains.

Armstrong Bros. Tool Co., Chicago; Tool Holders

The Lunkenheimer Co., Cincinnati; Tin Hanger illustrating valve.

Penberthy Injector Co., Windsor, Ont.; Oilers, Injectors, etc.

The Unbreakable Pulley and Mill Gearing Co., Manchester, England; Card showing Self-Oiling, Swivel Bearings in New Type Hangers.

Chicago Pneumatic Tool Co.; "Something Pneumatic;" a monthly magazine to be issued by them, the character of which is indicated by the title.

THE AMERICAN MACHINIST AND THE METRIC SYSTEM.

Editor, Canadian Engineer:—

Sir,—I note your article in the issue for April, entitled "Metric Measures and Weights," and that in it you state that the American Machinist strongly advocates the Metric System. In this you are mistaken. The American Machinist has not advocated the Metric System and does not advocate it. It has opened its columns to contributions from such men as have had experience with both the English and Metric Systems in the construction of machinery either here or abroad. It has published all communications received from men having had such experience, whether favorable or unfavorable to the Metric System. It happens that practically all the communications so received have been in favor of the system, but we should be as willing to publish those which oppose the system if we were to receive them. While this indicates, of course, that those who have had experience with both systems prefer the Metric, it does not say that the American Machinist advocates the Metric System.

We have, however, attempted to show that the pending bill before Congress is a moderate and proper one, and that it will not impose any hardship upon American manufacturers. This we believe to be true, and we do not believe you are correct when you say that this bill proposes to make the Metric System compulsory in America after a certain date. What it does propose is to make the Metric System the only one in use by the several administrative departments of the United States Government after a certain date. This, we believe, will simply have a tendency to facilitate the general introduction of the system, but do not believe that it will compel its introduction.

Truly yours,

FRED. J. MILLER,

Editor, American Machinist.

New York, April 12th, 1904.

YOU HAVE ONLY TO ASK.

A. A. Dion, Ottawa, editor of the "Question Box" department of the Canadian Electrical Association, has issued circular No. 3, the suggestions in which are reproduced below.

Mr. Dion has evidently spent much time on his department, and it is satisfactory to learn that the responses have been fairly plentiful. Answers to questions will in the main be deferred till the next convention, but where answers are urgently required, he will send them personally on receipt of a stamped, self-addressed envelope. The following are the questions asked:

A. The C.E.A. having decided, at the convention of 1903, in Toronto, to recommend to the members the system of accounting previously adopted by the N.E.L. Association, do you recommend printing and distributing the booklet, containing a description of the system, at a cost not to exceed $50?

B. Do you believe the interests of this Association would be better served by the election of a larger Executive Committee, which would make it possible to give a chance to more of those who are desirous of working actively for the society's welfare?

C. Would the appointment of assistant or local secretaries in large centres of population be conducive to the progress of the Association and the interest of the members individually?

D. (a) Would you recommend the appointment of a strong and active committee to collect data of interest to members; such data to be distributed from time to time during recess between conventions? (b) What data should be collected?

E. Should this Association be mainly an electric light association with company membership as the N.E.L. Association?

F. Is there too much time spent at conventions, in attending excursions and entertainments, and should more time be devoted to business?

G. What would you suggest as the best means of bringing into our Association the many operating companies not now represented?

H. Can you suggest any improvement in the manner of conducting meetings, discussions, etc.?

I. Have you any other suggestions to offer?

So far, 76 questions have been submitted for answer at the forthcoming convention.

L'ASSOCIATION PROVINCIALE DES INGENIEURS MECANICIENS.

The annual meeting of the L'Association Provinciale des Ingénieurs-Mécaniciens (Provincial Association of Stationary Engineers), Court Cartier, was held last month in Montreal, when the following officers were elected: Richard Marchand,

Richard Marchand.

president; Ephrem Brisebois, 1st vice-president; Alcibial Leprohon, 2nd vice-president; Etienne Leroyer, treasurer; Alexandre Bélair, recording secretary; Johnny Joly, financial secretary; Télesphore Leclaire, introducer; Omer Fontaine,

Ephrem F. Valiquet.

door-keeper, Rosario Drouin, Alphonse Collin and Charles Coulombe, auditors; Louis Thibault, caretaker; Richard Marchand, Rosario Drouin and Ephrem F. Valiquet, delegates to executive council; Ephrem F. Valiquet, instructor.

This Association [illegible] for the [illegible] improvement of its members, and is [illegible]. The new president is Inspector of Boilers for the [illegible] real, and is widely and favorably known in that [illegible] Valiquet, who ably fills the post of instructor, [illegible] of the machinery in the new grain elevator of the Harbor Commission.

CANADIAN ELECTRICAL ASSOCIATION.

At a meeting of the Executive Committee of the Canadian Electrical Association, held on the 21st April, it was decided to hold the next annual convention in Hamilton on Wednesday, Thursday and Friday, June 15th, 16th and 17th. Committees were appointed to make the necessary arrangements, and interesting papers will be read.

The Committee on Papers, of which R. G. Black is chairman, have succeeded in securing a very valuable and instructive series of papers by well known authors.

Much interest is being taken by the members in the Question Box, which, under the able direction of A. A. Dion, of Ottawa, promises to become a source of much valuable information to the members.

There is much of interest to electrical men to be seen in and about Hamilton. Many changes and improvements have been made to the Hamilton Electric Light and Cataract Power Company's system since the Association last met there. There is also the new works of the Westinghouse Electric and Manufacturing Company. Probably a day will be spent in visiting the great power development works in process of construction at Niagara Falls.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

At the meeting of the above society, on the 14th ult., a ballot for new members and transfers of members from one class to another was opened with the following result:

ASSOCIATE MEMBERS.

Charles Burnby Bell, of Montreal; Thomas Edward Lamb, of Montreal; Miles Penner Cotton, of Winnipeg; Lauritz Nicolai Jenssen, of Quebec; John Bell McRae, of Ottawa; Joseph Ovila Montreuil, of Quebec; Edward Godfrey Poole, of Halifax, N.S.; Hendry James Durie Ross, of Ottawa; Karl Weatherbe, of Windsor, N.S.

TRANSFERRED FROM THE CLASS OF ASSOCIATE MEMBER TO THE CLASS OF MEMBER.

John George Gale Kerry, of Montreal.

TRANSFERRED FROM THE CLASS OF STUDENT TO THE CLASS OF ASSOCIATE MEMBER.

Raoul de B. Corriveau, of Ottawa; Casimer Stanislaus Gzowski, Jr., of Toronto; Frederick T. Kaelin, of Montreal; John Herbert Larmonth, of Peterboro, Ont.; Julian C. Smith, of Montreal; John Ablet Walls, of Montreal.

ASSOCIATES.

Noulan J. F. Cauchon, of Montreal; Robert Edmund Pringle, of Montreal; Harry Wilson, of Montreal.

STUDENTS.

Edmund Joseph Bolger, of Kingston; Edgar Thomas J. Brandon, of Niagara Falls, Ont.; John A. Brundage, of Niagara Falls, Ont.; James Henry Bird, of Smith's Falls, Ont.; Frederick Fieldhouse Clarke, of Smith's Falls, Ont.; Henry J. Crudge, of Montreal; Camille Arnauld D'Abbadie, of Winnipeg, Man.; Victor A. G. Dey, of Montreal; Arthur Stewart Eve, of Montreal; Gordon B. Glassco, of Montreal; Lionel Edward Howard Grant, of Toronto; John Burcke Harvey, of Lyndhurst, Ont.; Thomas H. Hogg, of Chippewa, Ont.; William Dawson Lawrence, of Maitland, N.S.; Jason F. Mack, of Moncton, N.B.; Alister Maclean, of Montreal; Allan Getchell McAvity, of Toronto; Fred. Gordon McPherson, of Halifax, N.S.; Michael J. Murphy, of Halifax, N.S.;

Frank Peden, of Montreal; Herbert Lawrence Price, of Montreal; William Redpath, of Montreal; Max Veitch Sauer, of Niagara Falls, Ont.; Alexander Gibson Tapley, of Moncton, N.B.; Stuart Mills Thorne, of Niagara Falls, Ont.; Geo. Boyd Webster, of Montreal; John S. M. Wynn, of Niagara Falls, Ont.

THE ORILLIA DAM FAILS.

A break occurred at the base of the concrete dam of the municipal plant of Orillia, at Ragged Rapids, on the Severn, on April 7th, allowing the water to escape to such an extent as to lower it below the flume inlet, closing the plant and leaving the town without power or light. Some of the factories had steam plants on which they could fall back; others have been forced to put it in. The water supply can be kept up to some extent by one of the old engines. For light, coal oil has to be used. The accident is doubtless due to faulty construction, and the council has resolved, after a thorough examination, to abandon the dam and blast a tunnel through the rock from the head of the rapids to the power house. The tunnel will be 8 by 12, and 1,500 feet long. A shaft will have to be sunk at the head of the rapids, and a bulkhead built at the power-house. The plan is that the water will run through the tunnel, and rise in the bulkhead to the level of the river above. This will give five feet more head than at present, and there will be a proportionate increase in the amount of power available. It is roughly estimated that this plan can be carried out for $21,000. The cost of building a coffer dam, to keep the water away while repairs were made to the concrete dam, was estimated at $26,000. This would be a mere preliminary, and the repairs would have to come afterwards. It is doubtful if a good job could be made. The dam is very faulty in construction, and has been the cause of much litigation between the town and the contractor. Another section threatens to give way.

The town council has also decided to install a complete auxiliary steam plant in the old electric light station, and supply power during the day as well as light at night. The total cost of the auxiliary plant will be about $7,000, against which can be set $2,200 obtained for the old engines. The plant will supply about 3,500 lamps at night and over 300-h.p. during the day. An engine has been secured at Hamilton, with a capacity of 350-h.p. Negotiations are proceeding for a new generator, on the two-phase system, the same as the Ragged Rapids plant. It will cost about $2,500. It is also proposed to put in a new boiler. The auxiliary plant is expected to be in working order within four weeks.

STEAMBOAT ENGINEERS.

The following have been appointed engineers on the boats named for the coming season:

Richelieu and Ontario Line: Kingston, A. R. Milne; Toronto, W. A. Black; Bohemian, G. Gendron; Spartan, R. G. Marshall; Corsican, W. S. Parker; Hamilton, A. Demartigny; Algerian, C. Gendron.

Hamilton Steamboat Co.: Macassa, Oscar Flumerfeldt; assistant, A. Tompkins.

Montreal and Lake Superior Transportation Co.'s Line: J. H. Plummer, R. Chalmers; H. M. Pellatt, J. Byers; A. E. Ames, S. Gillespie.

Algoma Transit Co.: King Edward, S. Beattie; Minnie M., J. Grimes; Polaki, James Greig; Leafield, A. Foote; Theano, J. L. Smith.

Other appointments are: Wexford, D. McLeod; Strathcona, F. Smeaton; W. D. Matthews, E. J. Odell; Newmount, J. W. Aston; Donnacona, C. Dugold; Westmount, H. Young; Turret Crown, W. Robinson.

MCGILL DEGREES AND HONORS.

The degree of M.Sc. has been granted by McGill University to J. Lester W. Gill, B.Sc., professor in the Mining School, Kingston; J. E. Egleson, Charles M. McKergow, and John F. Robertson, lecturers in the mining faculty of McGill.

The following students of the Faculty of Applied Science have been awarded prizes for work done last summer: Prize for summer thesis in civil engineering course, John B. Harvey. Prize for best summer thesis in electrical engineering course, George K. Macdougall. Prize for the best summer thesis in mechanical engineering course, William F. Drysdale. McCarthy prizes for surveying field work: First prize, Thomas M. Fyshe; second prize, Douglas C. Livingston.

The following have passed for the degree of Bachelor of Science. (In order of merit):

Chemistry—Frederick M. G. Johnson, Montreal; Arthur Gordon Spencer, B.A., Truro, N.S.; F. J. Le Maistre, Westmount; William Gilbert MacNaughton, B.A., Huntingdon.

Civil Engineering—Samuel Blumenthal, Montreal; William D. Lawrence, Maitland, N.S.; John B. Harvey, Lyndhurst, Ont.; Aubrey A. Blanchard, Charlottetown, P.E.I.; F. T. Lucas, Hamilton; Stratton H. Osler, Cobourg; H. F. J. Lambart, New Edinburgh; Henry J. A. Haffner, Winnipeg; Gordon T. Jennings, Toronto.

Electrical Engineering—George K. McDougall, Montreal; George Herbert Cole, Ottawa; John H. Cardew, South Beach, Ont.; George W. Scott, B.A., Montreal; Frederick W. McCloskey, Boiestown, N.B.; John A. Wenger, Ayton, Ont.; Alexander S. L. Peaslee, Denance, Ohio; Howard K. Dutcher, Charlottetown, P.E.I.; Louis H. Marotte, Westmount; J. S. H. Wurtele, Actonvale; Harry E. Blatch, St. John's, Nfld.; Herbert F. Rodger, St. John's, Nfld.; M. Roffey, Braintree, Essex, Eng.

Post Graduate Course—Frederick B. Brown, B.Sc., Montreal; F. A. MacKay, B.Sc., Montreal; George Gordon Gale, B.Sc., Quebec.

Mechanical Engineering—C. J. Chaplin, Westmount, Que.; William F. Drysdale, Montreal; Robert A. Kemp, Beamsville, Ont.; John W. G. Greey, Toronto; F. C. D. Wilks, Brantford.

Mining Engineering—James M. McPhee, Loch Katine, N.S.; Norman W. Parlee, Rossland, B.C.; James H. Grice, Bootle, Eng.; Ernest J. Carlyle, Woodstock, Ont.; Robert A. Chambers Truro, N.S.; Reginald F. Taylor, Gananoque; Charles C. Richards, Charlottetown, P.E.I.; Gordon O. McMurtry, Montreal; Colin St. George Campbell, Aldershot, Ont.; Geo. Boyd Webster, Montreal; Patrick Moy Davis, Windsor, Ont.; Harold J. Doyell, Port Hope; Michael H. Sullivan, Ottawa, Ont.; John A. Cameron, Toronto; William D. Wilson, Hamilton.

Ernest George Gnaedinger, Montreal.

The Grand Trunk Railway may install an electric plant in their new machine shops at Barrie.

LITERARY NOTES.

Statics by Algebraic and Graphic Methods. By Lewis J. Johnson, C.E. 8vo. 133 pages, 42 figures and six double page plates. Price, $2. Published by John Wiley & Sons, New York, and Chapman & Hall, London.

This book is intended chiefly for students of engineering and architecture, and the author, who is assistant professor of civil engineering in Harvard University, aims to give the starting points of the science so as to make clear the deductions. Other purposes are to show the mathematical limitations of pure statics; to develop the analytical and graphic methods of solution side by side. The problems are so graded as to give a progressive illustration of principles, and to show how they are used in engineering practice. The advantages of the graphic method are shown in problems involving complicated geometric relations. Among other sources, Rankin's "Applied Mechanics" and Hoskins' "Graphic Statics" are drawn on to a considerable extent.

Metallurgical Laboratory Notes. By Henry M. Howe, professor of metallurgy in Columbia University. Published by the Boston Testing Laboratories, Boston, Mass.

The author's purpose is to teach, by the analytical method,

not individual processes, but the underlying principles applied to each case. This is done by a series of distinct experiments, and the author seeks to concentrate the student's attention upon the leading principle, illustrated in each experiment. "It seems clear," the author contends, "that instruction in general should as far as possible deal with principles rather than with the details of practice," hence his departure from the beaten track by showing a principle in each experiment. There are, in the 128 pages, 91 experiments set forth, with occasional illustrations, and an appendix containing tables of atomic weights, of molecular weights, melting and boiling points, of various metals and compounds.

Entropy; or Thermo-dynamics from an engineer's standpoint. By James Swinburne. Small 8vo., 137 pages Diagrams. Price,. 4s. 6d.. Published by Archibald Constable & Co., Limited, 2 Whitehall Gardens, London, Eng.

The author seeks to correct the inaccurate definitions used in treatises on thermo-dynamics, and gives the student a clearer notion of the physical meaning of entropy. He recalls his own difficulties as a student, and now endeavors to make meanings clearer.

Roads and Pavements. By Ira Osborn Baker, C.E., professor of civil engineering in University of Illinois. 8vo. 655 pages; 171 cuts, and 68 tables. Price, $5. Published by John Wiley & Sons, New York, and Chapman & Hall, London.

This is a comprehensive treatise on road making and street building, and confirms the good opinion expressed by engineers who have used his earlier work on "Masonry Construction," as a guide who aims to provide for every contingency that may arise, and states all the essential facts that require to be known on the subject. While the treatment is concise, the whole scope of the work is confined to roads proper; bridging, tunneling, retaining walls, etc., being left to other works treating on those topics. The headings of some of the chapters convey some idea of the book. After showing the financial value of good roads and street paving, he deals with location, earth roads, gravel roads, macadamized roads, race tracks and miscellaneous roads. In the department of city streets he deals with street design, street drainage, curbs and gutters, pavement foundations; asphalt, brick, cobble stone, stone block, wood block, and other pavements; comparison of cost, etc., and a chapter each goes into sidewalks and bicycle and race tracks. Materials and their cost are, of course, chiefly based on conditions and prices in the United States.

Other publications received are:

"Electric Coal Cutting," a reprint of a paper read before the Institution of Mining Engineers of Great Britain (London and Newcastle-on-Tyne) at the last annual meeting. The writer describes various types of machines, and indicates the class of coal and situation of mines where coal cutting machines may be profitable.

"Subject-Matter Index of Mining, Mechanical and Metallurgical Literature for 1901." Published by the North of England Institute of Mining and Mechanical Engineers (Newcastle-on-Tyne, England); 151 pages in paper covers; price, 42s. The issue for 1902 is in preparation. An earlier publication would add much to the value of the work.

The April number of Mines and Minerals, Scranton, Pa., is a special number on wire ropes used in mining operations. It contains a mass of useful information on the subject, much of which has never been collected in one publication.

Taking the lives of Senator Wark and Prof. Goldwin Smith, as a text, the editor of the Canadian Magazine preaches a timely sermon on the health of the Canadian people. Self-denial, he urges as the first need, and he cites the Japanese as an example of a people noted for their self-restraint. He concludes: "If Canadians are to be physically strong, they must eat less pastry, they must breathe more fresh air, they must encourage still more athletic sports and physical culture, they must realize that the reckless pursuit of "the dollar," is not a reasonable ambition for either an individual or a nation, but that strong bodies and sound "minds are the marks of a vigorous race."

"The Patternmaker" is a new monthly, issued at Cleveland, O., by the Iron and Steel Press Co., at $1 a year. It contains 38 pages of reading matter, size of page, 7 [illegible] is well printed, and contains many valuable hints for the pattern shop man. A sample copy will, no doubt, be sent on application.

THE GREAT WEST

H. J. Fuller, general manager of the Fairbanks Co., for Canada, has returned from a trip to the Pacific Coast. In conversation with a representative of the Canadian Engineer, Mr. Fuller says of affairs in the West: I believe that British Columbia is going ahead as rapidly, if not more so, than any province in the Dominion to-day. The lumber mills are complaining of low prices which they are receiving, at the same time new mills are constantly going up, and the C.P.R. has reduced the freight rates on lumber in British Columbia to Winnipeg and Manitoba points, which should help largely to increase the output.

As regards the fisheries, they are not expecting a large run of salmon this year; the year after next the salmon are expected to run in large quantities. The north trade is largely in the hands of commercial companies, who have business in the United States and very little trade, proportionately, is going to Canada, although they purchase in Montreal certain goods. At the same time the expense of travelling in that district prevents manufacturers from doing missionary work and introducing their specialties in that country, as they would elsewhere.

There are a large number of coal mines constantly being opened upon the Crow's Nest Pass line, and anthracite mines on the main line of the Canadian Pacific, near Banff. The latter-named road controls large mines, and is, at present, putting in an extensive plant for operating it.

The severe winter has affected the cattle trade very much; it is impossible, however, to get an accurate estimate as to how many cattle were lost, but dead cattle could be seen all along the way through the ranching country.

The expectation is that an equally large number of settlers will go into Manitoba and the North-West Territories the coming season as went in last year. The fact remains, however, that the crop last year was very small and disappointing, and a great many chattel mortgages were placed on property of merchants in the smaller towns, and jobbers are carrying a large amount of paper which is, of course, an unhealthy condition and one sure to exist in any country depending upon one crop. Every effort is being made to get the farmers to diversify their crops and ensure more steady returns.

INDUSTRIAL NOTES.

The Newington, Ont., peat works are to be enlarged and more machinery added.

Collingwood still hopes to get the tin plate industry of which Mr. Lewis is the promoter.

The capital of the Montreal Pipe Foundry Co. has been increased from $150,000 to $250,000.

Frothingham & Workman, wholesale hardware dealers, of Montreal, have been incorporated as a joint stock company.

The Leroy Automobile Co. talk of leaving Berlin. They want more room and the town council declines to grant exemption.

F. A. Wegner, president of the Frontenac Cereal Company, of Kingston, is asking what encouragement Medicine Hat will give for similar works there.

Chris. Kloepfer, of Guelph, has had plans drawn, at Galt, for a large wood-working plant, to cost $12,000. The factory will produce woodwork for buggies, wagons and cutters.

The Frost Fence Co. is about to move from Welland to Hamilton, where a two-story brick factory, about 150 by 50 feet will be erected at once. The company employs about forty hands.

The alabastine works, at Paris, Ont., have been burned.

A by-law is to be submitted at Sherbrooke, Que., to give a bonus of $10,000 to a smelter.

The contracts have been let for a large tannery at Ottawa, to cost $75,000.

The Northern Elevator Co. will erect a flour mill at Winnipeg, with a capacity of 2,500 barrels.

J. Butchart, of Owen Sound, according to the Victoria Times, is about to start cement works at Tod Creek, B.C. He will commence with about 200 barrels a day, but hopes soon to manufacture daily 800 or 1,000 barrels.

The rod mill of the Dominion Iron and Steel Co., at Sydney, C.B., is about completed. The Morgan Construction Co., which built it, is about to erect similar works in several places in Germany and France.

A new carriage factory, at Stratford, Ont., will make a vehicle with a patent attachment by which, when turning, back and front wheels turn simultaneously, so that but a small space is needed, and there is no danger of an upset.

The town of Niagara-on-the-Lake has voted a bonus of $15,000 and exemption for twenty years to the Niagara, Queenston and St. Catharines Railway to build an electric railway from St. Catharines to Niagara-on-the-Lake, thence along the bank of the Niagara river to Queenston.

The Toronto branch of the Fairbanks Co., described in our March issue, was destroyed in the great fire, but this will not interfere with their business, as they have secured temporary quarters at 124 Bay St. As a complete line of goods is kept in stock by the Montreal headquarters, they can promise to fill all orders as usual. They will, just as soon as possible, rebuild.

The Dodge Manufacturing Co., of Toronto, Limited, who in January last opened a branch office and wareroom at 410 St. James St., Montreal, report very gratifying results from that quarter. The Montreal office is in charge of Frank F. Young, formerly of the sales department, Toronto. Mr. Young says most of the mills prefer taking their requirements from the maker when it is made convenient to do so, and as Montreal is the distributing centre for the eastern part of the province, he finds a ready welcome for Dodge products.

The Grand Trunk elevator, at Midland, was recently struck by lightning, resulting in its total destruction by fire. It was built in 1882, and enlarged ten years ago, having a capacity of 500,000 bushels. It was rented by E. R. Bacon, of Chicago, and a large business was anticipated the coming season. Four large grain steamers, frozen in near the elevator, had a narrow escape. When the lightning struck the elevator it shattered it from top to bottom, lifting whole sections of the roof and throwing down some of the large timbers.

The Locomotive and Machine Co.'s works, at Longue Pointe, near Montreal, recently taken over by the American Locomotive Co., has received orders for 13 new engines from the Grand Trunk, Canadian Pacific, Toronto and Buffalo, and Cape Breton railways. They have on hand nearly 3,000 tons of iron purchased in Germany and more is on its way to this country. They intend to procure all their iron from Germany or England, as it can be purchased there at better prices than at Pittsburg. All the other supplies will be bought in Canada.

A company, known as the Cape Breton Iron and Steel Co., has been formed to establish new iron works at Sydney. Two steel buildings will be erected having expanded metal sides, roofing fireproof, each 100 feet wide by 150 feet long, one of the buildings to be used as a steel and iron foundry, the other for a machine and forge shop. Another building 40 feet wide by 50 feet long will be used as a clipping room for castings, etc.; pattern and carpenter shop 35 feet wide by 60 feet long; power station, containing boiler, engine, electric generator, air compressor, etc.; office building; storage building; gas producer, etc. It is the intention to erect the plant in sections putting each into active operation and on a dividend-paying basis as soon as it is completed. It is estimated that about $100,000 will be expended on construction work this year.

Baird Bros. will rebuild their furniture factory at Plattsville, Ont.

As will be seen in a card elsewhere, a member of the Institute of Mechanical Engineers of Great Britain, having had practice in India and in British Columbia, is open for an engagement as consulting engineer or to take charge of works.

In consequence partly of labor difficulties, common to the bookbinding and printing trades in Toronto, the Barber & Ellis Co., manufacturing stationers, who were burned out in the Toronto fire, will rebuild in Brantford, Ont.

The Mansfield Glass Works, of New York, with a capital of $200,000, and employing about 150 men, have decided to establish a Canadian branch in Hamilton, and the Petrie Machine Co., manufacturers of cream separators, recently burnt out at Guelph, have also decided to rebuild at Hamilton.

H. and W. H. Bunker, of Lisle, Ont., are said to be the inventors of a unique machine for converting straw into wood or fuel. The machine rolls the straw so tightly that it is as tough as a stick of timber. The product, used as fuel, is much cheaper than either coal or wood, and gives an intense heat. A number of machines are to be built.

The Goldie & McCulloch Company, Limited, Galt, have decided to erect large new boiler shops on the property they bought a year or so ago at Hunter's Corners, on Preston road, between the lines of the Grand Trunk and the Galt, Preston and Hespeler Street Railway. Contracts have been awarded. The shops will be over 300 ft. long, will be built largely of steel, and will be equipped with the most modern machinery in the world for boiler manufacture. The company's capacity in this branch will be greatly increased. The change has been made necessary for two reasons, first, their growing trade, and second, the necessity of having railway switches to expedite shipping.—Galt Reporter.

The Keewatin Flour Mills Co. has been incorporated, with a capital of $2,000,000, to build a large flour mill at Keewatin, on the main line of the C.P.R., 129 miles east of Winnipeg, where the Winnipeg river water power is available to the extent of about 5,000-h.p. The mill will have a capacity of 3,000 barrels a day, and will be so designed as to be capable of enlargement when required. The provisional directors are: John Mather, Ottawa; Angus W. Fraser, K.C., Ottawa; Robert M. Cox, Ottawa and London, Eng.; Edwin C. Whitney, Whitney; David L. Mather, Rat Portage; Hon. James D. McGregor, New Glasgow, N.S.; R. L. Borden, K.C., Halifax; George Burn, Ottawa; Hon. E. H. Bronson, Ottawa, and John Coates, London, Eng., and Melbourne, Australia.

A new company has been formed to consolidate several of the oil companies doing business in Canada. It is called the Canadian Oil Co., Limited, with head office in Toronto and capital $1,500,000. The companies absorbed by the new company are: The Union Petroleum Co., Limited, the Grant-Hamilton Oil Co., of Toronto; the Sun Oil Co., Limited, Hamilton, Ont.; the McCord Oil Co., Petrolia; Canadian Oil Refining Co., Petrolia; Sterling Oil Works, Marietta, Ohio; Walker Oil Co., Winnipeg; Gall-Schneider Oil Co., Montreal; Canadian Oil Refining Co., Petrolia. The officers and directors are: William Irwin, Peterboro, president; James Playfair, Midland; E. R. Clarkson, Hamilton; John J. Main and D. B. Hanna, of Toronto, vice-presidents; W. W. Cummings, treasurer; W. J. Shephard, Waubaushene; W. J. Lovering, Toronto; R. R. Hall, Peterboro; W. D. Lummis, Toronto; Joseph Wright, Toronto; John J. Kerr, Petrolia; Thos. Ramsay, Hamilton; Leopold Bauer, Hamilton; W. P. Bull, Toronto, directors. Thos. H. Hamilton is general manager of the new company, which will have a meeting the first or second week in May by which time the organization will have been completed.

S. H. Colburn, general manager of the Colburn Machine Tool Co., Franklin, Pa., returned from the Continent last month. During his trip he successfully secured representation for his firm's products in Great Britain and the Continent.

LIGHT, HEAT, POWER, ETC.

The Water Commissioners [illegible] Windsor, Ont., will ask for tenders for an electric plant at the pumping station.

Chesterville is to be lighted with acetylene gas. The Continental Light and Heat Co. has been given a ten years' franchise.

The Consumers' Electric Co., Ottawa, will spend $30,000 on conduits for their wires between their generating plant and their former station.

The Shawinigan Water and Power Company will construct a second transmission line from Shawinigan Falls to Montreal, to transmit 10,000-h.p.

The Barrie Gas Co. has reduced the price of gas, with a special reduction to those who consume at least 3,000 ft. per quarter and use gas for fuel the entire year.

The Mayor of Kingston favors getting power from the Mississippi. The city would erect its own transmission line, and could supply power at from $10 to $12 per horse-power per annum.

The Privy Council has given judgment in favor of Kingston in its suit with the Light, Heat and Power Co. The effect is that the city is not required to pay the company anything for its franchise.

The windmill lighthouse at Prescott will hereafter be lighted with acetylene gas, as will nearly all the Canadian lighthouses along the St. Lawrence. By the use of acetylene great economy will be effected.

The St. Thomas Gas and Electric Light Company, St. Thomas, Ont., propose to increase their capital for the purpose of extending their plant. The city council, however, is taking steps with a view of buying them out.

The Chambly dam of the Montreal Heat, Light and Power Co., which was swept away last year, has had a pretty severe test this season. Five out of seven spans of an iron bridge were carried away and lodged against the dam.

The Department of Railways and Canals have let the contract for the electric lighting of the Welland Canal from Port Colborne to Port Dalhousie, to the Canadian Westinghouse Co., Hamilton. Between 600 and 700 lights will be required. The power will be obtained from De Cew falls.

An interesting departure in engineering practice by the authorities of the United States Navy, Department of Yards and Docks, is marked by the introduction of Westinghouse-Parsons steam turbines for furnishing power for lighting the buildings and yards, and power for operating dry dock pumps and miscellaneous machinery.

G. A. Powell, sales manager of the Packard Electric Co., Limited, of St. Catharines, leaves in a few days for Winnipeg to open a branch office of his company there. Mr. Powell will remain in charge of the Winnipeg office until the organization is perfected. With a branch office in the east at Montreal, and in the middle west at Winnipeg, the company is in a good position to care for the demands of their rapidly increasing business.

The Volta Electric Repair Works has been established at 86 Adelaide street West, Toronto, under the proprietorship and management of D. McGregor Johnston. The Volta works will be devoted exclusively to the repairing of electrical apparatus of all kinds. Mr. Johnston understands thoroughly the construction of electrical machinery both for direct and alternating current systems. He has had over twelve years' experience, and, being a graduate of the School of Practical Science, of Toronto, has technical knowledge as well as shop practice.

The engineers of the Mexican Light and Power Co., a Canadian company that is installing the great water power and electric transmission plant in the State of Pueblo, ninety miles from Mexico, found that the town of Necaxa, with a population of about 1,000, occupied a site particularly suitable for the necessary reservoir, and the company forthwith purchased the entire town and moved it to a new location. All the buildings, including the Catholic Cathedral, were razed and reconstructed on the new site. The new town bears the name of Canadita. The initial capacity of the company's plant will be 45,000-h.p., and this will be increased to 80,000.

The Perth [illegible] of the Perth Ele[illegible] municipal concern.

The Crocker-W[illegible] facturers of elect[illegible] from $1,000,000 to $2,000,000.

Stave River F[illegible] there is a 20,000-h.p. [illegible] Stave Lake Power C[illegible] work cutting a canal.

The Canadian General [illegible] Montreal shops to Peterboro [illegible] ment required for direct current [illegible] volve the transfer of about 100 ha[illegible] 200 will be retained at the Montreal [illegible] turing and repair work will still be [illegible].

The Montreal Light, Heat and Power [illegible] notice to electrical contractors in Montreal that [illegible] future refuse to make connections with 50 and [illegible] systems. All connections must now be made at 110 [illegible] nections will be made only at the front of buildings [illegible] actions for damages from carrying wires over r[illegible].

Mr. Jenison has, by an act passed at the late session [illegible] the Ontario Legislature, secured the control of the Kaministiquia water power near Fort William. It was formerly under his control but he failed to utilize it, and it passed to F. H. Clergue. Jenison wished to get it again, and there was a big fight between the two men during the late session. Finally, it was given to Jenison, who is bound under the terms of his agreement to develop it without delay, and under stringent conditions.

RAILWAY NOTES.

There are in Italy 1,600 miles of railway run by electric power.

The Central Vermont Railway bridge over the Richelieu was swept away by the spring freshets.

The American Car and Foundry Company, New York, is filling a contract for eighty-six ballast cars for the city of Winnipeg.

On United States railways, during the three months ending 31st December last, 1,160 people were killed and 13,3[illegible] injured.

The Guelph Herald says the construction of the railway from that city to Goderich is to be proceeded with at once. Wm. Davis, C.E., has completed the preliminary survey.

Application is being made for a charter for the Nipissing, Ottawa and Montreal Railway to run from Lake Nipissing to Montreal and from the former along French river to the Georgian Bay.

The Stratford Radial Railway Co., which already has a charter to connect Stratford with Mitchell and St. Mary's and Mitchell, will extend its electric road to Goderich. Work is expected to commence in May or June.

A blinding snowstorm was the cause of a [illegible] collision on the Grand Trunk Railway, near Simcoe, on the 15th of April, when considerable damage to rolling stock was done. A storm of such proportions in April is a rare occurrence.

Napanee will submit a by-law for a bonus of $2[illegible] for the proposed electric railway from Toronto to Cornwall. Trenton has agreed to take $20,000 worth of bonds [illegible] ville will be asked to take $50,000. The road w[illegible] $4,700,000.

The Berlin, Waterloo, Wellesley and L[illegible] Railway Co. asks for an amendment to its charter so [illegible] may build from Wellesley to Stratford, St. Marys, [illegible] and Bayfield. The company also seeks power to enter into an agreement with the Galt, Preston and Hespeler Railway Co., the Preston and Berlin Railway Co., or any other railway company.

Angus Sinclair, superintendent for Mackenzie & Mann in the construction of the Halifax and Southwestern Railway, promises to have a train into Halifax by June 1st.

An engineer has been instructed, on behalf of the various railways, to make a report upon an international bridge between Windsor and Detroit. The main points to be considered are the advantages and drawbacks, respectively, of a high bridge and a drawbridge.

M. P. Davis, contractor for the Quebec bridge, hopes the present season to grade the line connecting the southern end with Chaudiere Junction. Next season the erection will begin of the steel superstructure. This will take two years, and the contractor thinks that by 1907 the work will be complete.

President Ledyard, of the Michigan Central Railway, and President Newman, of the New York Central, have just made the trip from New York to Chicago on a special train of one baggage and three passenger cars. Over the M.C.R., in Canada, they made the world's record time for part of the distance—over 75 miles an hour.

Joseph E. Duval, recently appointed to the new position of inspector of railway accidents, will act under the recently organized railway commission. He comes of a family of railway men, his father having seen nearly forty years' service with the G.T.R., and he has three brothers in railway positions. He himself began when 14 as a G.T.R. telegrapher and for 18 years was chief despatcher for the Canada Atlantic, being promoted three years ago to car service agent. His first investigation in his new office was into the collision at Guelph.

MARINE NEWS.

A new ice-crushing ferry steamer, to run between Windsor and Detroit, is being built at a cost of $300,000.

The Dominion Marine Association recommends an enlargement of the Welland Canal to accommodate vessels of 6,000 tons.

The steamer A. B. Wolvin, the largest ever built on the Great Lakes, and the largest on any water for freight carriage, has been launched at Lorain, Ohio. She cost $500,000.

The St. Catharines Board of Trade advocates the construction of four miles of canal, from Lock 2 on the old canal to Marlatt's Pond, to relieve congestion on the Welland Canal.

The Canada Atlantic Transit Co. has withdrawn its line of steamers between Parry Sound and Duluth. It will continue to operate the line between the former port and Milwaukee and Chicago.

Steps are being taken at Victoria, B.C., to provide a steam life boat. A life-saving association has been formed, and equipment will be provided, the cost being defrayed by a special collection of funds, preferably on Victoria Day.

Bowring Bros., of St. John's, Newfoundland, will build two steamers for coast service, 200 ft. long, 31 ft. deep to main deck, with a speed of 12 knots, and specially designed for winter navigation. Meantime they will charter vessels.

The average length of ocean ships has increased some 50 to 60 per cent. within the last 25 years. The beam has increased still more rapidly. The draft has not increased in the same ratio, the depth of water in many harbors not permitting it.

A. B. Polson and J. B. Miller, of the Polson Iron Works, Toronto, have been in Great Britain and on the Continent looking over the shipyards for ideas in connection with marine architecture. Mr. Polson expresses the hope that Canada will in future build her own turbines.

Nap. Payette, of Penetang, has launched a big scow which he built for Clark & Pratt, of Parry Sound, to carry bark from Parry Sound to Penetang. It is 85 ft. long, 24 ft. wide, and has a hold depth of 6 ft. The deck and bottom are of 8-inch stuff bolted with inch iron bolts at intervals of 2 ft. It is said to be one of the best on the Georgian Bay.

The Reid Wrecking Company, of Sarnia, has been awarded the contract for the removal of the wreck of a burned steamer in the St. Clair river at Russell Island.

The Anticosti, the second of the light-ships ordered from the Polson Co. by the Dominion Government, was launched April 9th. She is in all respects like the Lurcher, launched last fall, and sent to Nova Scotia. The Anticosti will be stationed off the island after which she is named.

The hull of a new stern wheel steamer for the Hudson's Bay Co. will be built at Fort Vermillion, on Peace River, and it is probable that others will be built there subsequently. A. Watson, of Victoria, B.C., who will have charge of construction, has already superintended the construction of a number of similar steamers for the company on the Pacific coast.

The Scottish Hero, the first vessel to arrive at Sydney this season, and one of those chartered by the Dominion Iron and Steel Co., brought 370 tons of rails, manufactured in England from steel made at Sydney. They are to be sent to different parts of Canada to be tested. The Scottish Hero also brought 800 tons of firebrick and 9,980 barrels of cement, though cement is made largely in Canada.

A curious accident is reported from Winnipeg. The Gertie H., a small steamer, came in contact with the C.N.R. Railway bridge and lodged there. A stove was upset which set the steamer and bridge on fire. The burning vessel drifted off and next struck the Louise traffic bridge, setting it on fire. Finally it drifted ashore, and was burned to the water's edge. Both bridges were considerably damaged. The crew escaped by climbing on the bridge.

Two iron steamers are being built at the Bertram works, in Toronto, a grain carrier for builders' account, and a ferry boat for St. John, N.B. The former is 256 feet long, 42 feet beam, and 18 feet deep. She will be fitted with triple expansion engines, 15, 25, and 42 in. by 30 in., and two return tubular Scotch boilers, 10 ft. by 11 ft. The hull only of the ferry boat is being built in Toronto. She will be fitted up at St. John.

Plans for the big marine railway and dry dock of the Victoria Machinery Depot Co. have been completed by the H. I. Crandall Co., of Boston. This dock will be 65 feet wide and over 270 feet long, and have a carrying capacity of nearly 3,000 tons. The plans show very heavy class of construction, both in wood and steel. The steel has already been ordered from the mills, and the inspection of it placed with the De Lano-Osborn Engineering Co., of Toronto. It is intended to have the dock fully completed and ready for service by the middle of the shipping season, and it will add materially to the facilities of the port for handling large vessels.

MINING MATTERS.

The British Columbia lead producers are advocating a change in the lead bounties granted last session.

J. J. Rutledge estimates the output of gold from the Canadian Klondyke, since its discovery, as $125,000,000.

Geo. Weese, of Bancroft, Ont., has sold a corundum property in that locality to United States capitalists for $11,000.

It is reported that oil has been struck in paying quantities at Swift Current, about 40 miles south of Cardston, N.W.T.

A carload of cobalt from the recently discovered deposits on the Temiskaming Railway has been sent to St. Louis to the World's Exposition.

The Dominion Iron and Steel Co. will operate largely on the Bell Island iron deposits, Newfoundland, this season. A number of men have already gone, and the working force will be increased to about 2,000.

The A. Leschen & Sons Rope Co., of St. Louis, are sending to their friends and others interested, a useful souvenir in the shape of a celluloid wire rope gauge, which will gauge the standard sizes of wire ropes from ¼-in. up to 1¼-in.

The councils of St. Catharines and Merritton have petitioned Parliament for the imposition of an export duty of twelve cents a thousand feet on natural gas. The Provincial Natural Gas Company, with headquarters in Buffalo, is piping all its supply from the Niagara peninsula, while local residents cannot get any.

A rich strike in high-grade copper ore is reported from Oyster Harbor, just north of Ladysmith, B.C., close to the Tyee Copper Company's smelter. The discoverer is Robert Herd, a prospector. Samples treated at Victoria give $80 a ton in copper, $3 in gold, and $1.50 in silver. James Dunsmuir and Clermont Livingston, general manager of the Tyee Copper Company, have been negotiating with a view to purchase.

The British-American Company, of Victoria, which had a gigantic dredge built last year for recovering gold on Pine Creek, have let a contract in San Francisco for a larger one. The present dredge is capable of handling 3,000 yards of grale a day. The new one will have 5,000 yards' capacity, and will work on the Spruce Creek electric plant from the falls on Pine Creek, which will give power to both. Philadelphia capital is interested.

At a recent meeting of the executive council of the Canadian Mining Institute, the president, Eugene Coste, was requested to act as secretary of the Institute, in succession to the late B. T. A. Bell, till the next annual meeting. Mr. Coste's address is 18 Toronto St., Toronto. We understand that J. E. Hardman, mining engineer of Montreal, will for the present conduct Mr. Bell's paper, the Canadian Mining Review, the publication office of which will be moved to Montreal.

PERSONAL.

James M. Sinclair, manager of the Eureka Mineral Wool and Asbestos Co., Toronto, returned a few days ago from a trip to New York, Philadelphia, and other cities, in the interests of his firm.

John L. Weeks, treasurer and general manager of the American Steam Gauge and Mfg. Co., Boston, died on the 2nd ult. He had been connected with the company for over thirteen years, and the loss of his faithful services is keenly felt, not only by the board of directors and stockholders, but by a large circle of business acquaintances.

The following graduates of the School of Practical Science, at Toronto, have secured contracts for surveys in the North-West this coming summer, and will take out in their parties a number of students of the school: Messrs. C. Harvey, H. H. Moore, H. J. Bowman, C. C. Fairchild, H. S. Holcroft, R. H. Knight, J. W. Tyrrell, M. B. Weeks.

A. F. Brown has been appointed manager of the Machine Tool Department of the Fairbanks Co.'s Toronto branch. Mr. Brown was formerly connected with the Packard Machinery Co., Chicago, and has a record as a successful machinery salesman, and will, no doubt, owing to his practical knowledge, make his firm first in the territory over which he has been placed.

George Dawson, senior partner of Dawson & Riley, the contractors for sinking the large wheel pit for the Canadian Niagara Power Company, died suddenly in his office at the works, Niagara Falls, on the 21st April. Heart failure is supposed to have been the cause of death. Mr. Dawson was 76 years of age, and was widely known in both Canada and the United States, having constructed many large works throughout the country.

The Canadian Westinghouse Company, Limited, of Hamilton, Canada, have recently engaged C. C. Starr, who was formerly connected with the firm of John Starr, Son & Company, to act as their representative in the Maritime Provinces, with headquarters at 134 Granville street, Halifax, Nova Scotia. The Maritime Provinces are included in the district of the Canadian Westinghouse Company's Montreal office, and Mr. Starr will be consequently an attache of that office.

R. C. Trott, late engineer at the Reformatory, at Penetanguishene, Ont., died last month at Brentwood, aged 66. In a private note to the Canadian Engineer [illegible] Mr. Trott expressed his belief that his time here w[illegible] and took occasion to put on record in th[illegible] interesting facts concerning the fitting out a[illegible] repa[illegible] Great Eastern, on which he worked.

The following have obtained the degree of Bach[illegible] Science at Queen's University: Thomas Brown, Hawkes[illegible] (in mining); T. Wm Cavers, Carleton Place (in mining); L. T. Corkill, Sydenham (in mining); E. M. Dennis, W[illegible]stock (in mining); M. V. Ferguson, Kingston (civil engineering); J. V. Gleeson, Kingston (chemistry and mineralogy); E. V. Malone, Toronto (in mining); R. B. McKay, Cornwall (in mining); K. R. McLennan, Lindsay (civil engineering); F. R. Reid, Kingston (chemistry and mineralogy); R. L. Squire, Kingston (civil engineering); H. Walker, B.A., Morewood (civil engineering); A. R. Webster, Gananoque (electrical); J. K. Workman, Kingston (mineralogy and geology).

TELEPHONE AND TELEGRAPH.

The Dominion Government has just completed a telephone line to Ganges' Harbor, Salt Spring Island, B.C.

The Bell Telephone Company will not accept the offer of the Ottawa city council of five years' exclusive franchise, provided the company put in house 'phones at $23, instead of $25, and charge only $5 additional for a desk extension where a wall 'phone is installed.

The Huntsville Lumber Company is having installed a telephone service at Moose Lake, two miles in length, connecting the driving camps with the stations along a tributary of the Big East, down which logs are driven. Notice can thus be sent back in case of a jam of logs instead of a messenger, as heretofore, saving much time.

The International Telephone Company will connect Victoria and other places on Vancouver Island with points on the mainland as far south as Portland, Oregon. The company will lay a four-ply cable by way of San Juan, Orca and Lummi island to Whatcom. It is understood that a rate of 50 cents will be charged for a one-minute conversation with Vancouver and 60 cents with Seattle.

A section of country ten miles north of Guelph is largely provided with rural phones. Especially are they used in connecting the farm dwelling with the barn and remote sections of the farm. The phones cost but $2.50 each, and the wire and other connections in the same proportion. It is possible for a farmer with an outlay of ten dollars to have three phones on his place connecting his various buildings. The cost of maintenance is said to be but one dollar a year for the entire system. In many instances farmers are having the individual phones installed, and later connected in the form of a neighborhood system.

MUNICIPAL WORKS, ETC.

Carleton Place town council is asking for $10,000 for perment sidewalks.

The floating bridge, at Pigeon Creek, near Peterboro, has been damaged by ice. The bridge is 4,400 feet long.

The by-law to raise $10,000 for electric light and waterworks improvements, at Mitchell, Ont., has been carried.

A rubber pavement, laid under the archway of Buckingham Palace and on several other private roads in London, is such a success that it is proposed that London should be made a city of silence by paving the roads with India rubber. The only difficulty is the cost, as the rubber paving costs $15 a square yard.

The dam on the Rideau, at Poonomale, above Smith's Falls, was carried away and let the Rideau Lakes' water out, doing much damage. It will be some time before repairs can be made by the Government. Temporary repairs to retain the water were, however, made within eight days. Making the repairs was a work requiring brains and skill. Just after the accident, nothing could be done owing to the large blocks

of ice which were coming donw. But as soon as the ice cleared, work was started. Large elm trees, which grew on the banks, were felled and converted into open cribs. By means of ropes these cribs were steered into place just above the break in the dam, and then held by tying the ropes to trees. Then stone was brought down on rafts and the cribs filled to the height of a couple of feet above the woodwork, thus holding the cribs in place without the ropes. The cribs were put into place in sections and when all were in formed a coffer dam just above the break, conserving the water as well as the old dam. This coffer dam keeps the water off the broken part sufficiently to allow the old dam to be rebuilt.

INTERNALLY FIRED VS. EXTERNALLY FIRED BOILERS.

The following is a contribution by D. W. Robb, of the Robb Engineering Co., Amherst, in the Engineering Magazine:—

It is generally admitted that theoretically the internally fired boiler should have a lower efficiency than any form which gives better space for combustion, and less close proximity of the fire to the cooling surfaces. It is not often that the two types of setting have been accurately and impartially compared, and hence data and results of trials, made by independent authorities upon boilers of nearly the same capacity, with practically the same coal, and under closely similar conditions, demand unbiased presentation. It must be clearly understood that the following article is not a comparison between two different makes of boilers, but between two different types of furnaces, types which are open to the entire engineering profession for use, both on land and at sea, the whole forming a valuable contribution to practical steam engineering.—The Editors.

Probably most engineers who are interested in steam-boiler construction and economy, have the opinion that a highly heated brick furnace is more favorable to the complete combustion of the volatile hydrocarbons contained in bituminous coal than the cool surface of an internal furnace surrounded by water; but I think it is at least open to discussion whether the more direct utilization of the heat in an internal furnace, by which radiation and air leakage are avoided, does not more than offset the other advantages of the brick furnace. With either arrangement of furnace, it is necessary to admit the proper proportion of air, and the air must be heated to a high temperature, say 1,400 degrees F., in order to produce combustion of the volatile gases. This air is more easily and more naturally heated by passing through the bed of fuel on the grate than in any other way. If cold air is admitted above the fire, combustion will be checked, even with a brick arch; or if a large amount of coal is thrown upon the fire at once, the air supply will be checked and cooled so that the volatile gases, which are being rapidly set free, will, to a large extent, pass off unconsumed for want of sufficient heated air. Therefore, the question of obtaining perfect combustion with either kind of furnace is largely dependent upon the skill and care of the firemen in having the fire of such thickness that the air supply will be properly regulated and in carefully spreading the fuel in small quantities over the fire.

This result may be obtained mechancially either by the system of underfeed stoking, or by down draft on the Hawley plan, by which the volatile gases are forced to pass through the bed of incandescent fuel, thus receiving the heat and air necessary for complete combustion. Either of these systems of stoking may be carried out in a steel furnace surrounded by water as well as in a brick furnace. It is necessary, however, to have the internal furnace large enough to permit complete mingling of the burning gases before them come in actual contact with the cooling surfaces, and in this respect furnaces of small diameter, such as are used in the Scotch or Lancashire types of boilers, are at fault.

In order to make a comparison of the actual economy of the two methods of burning soft coal for steam generation, a table is given, comprising four trials of steam boilers —two of a water-tube boiler, set in brick, fitted with Dutch oven in front, and two of a boiler of the internal furnace type. These trials were made at technical schools under the direction of careful and experienced men, and the results very fully and exactly recorded; they correspond closely in conditions, the boilers have about the same amount of heating and grate surface, the coal for three of the trials being from the same mine, and for the other trial of nearly the same calorific value.

The trials of the water-tube boiler with Dutch oven (A and C) are taken from a paper by Professor E. A. Hitchcock, of the Ohio State University, presented at the Saratoga meeting, June, 1903, of the American Society of Mechanical Engineers.

The trials of the internally fired boiler at McGill University (B and D) are taken from a report by Professor John T. Nicolson, D.Sc., formerly of McGill University, now director of mechanical engineering at the Municipal Technical School, Manchester, England, and Professor R. J. Durley, B.Sc., of McGill University.

Description of Boilers.—The equipment at the Ohio State University, especially constructed for the purpose of boiler and fuel testing, (referred to in trials A and C of the table annexed) consists of a water-tube boiler, a Green's fuel economizer, an air heater, induced and forced-draft fans. The boiler (of the Babcock & Wilcox type) has 56 4-inch by 16-foot tubes, and a 42-inch diameter drum, giving a heating surface of 1,070 square feet. The furnace is of the Dutch-oven or fire-brick-arch type with stationary grates, having an area of 25 square feet. The furnace projects in front, so that the front of the bridge wall is on a line with the front of the boiler, the arch extending 1 foot 6 inches beyond the end of the grate bars. The boiler is arranged so that it may be operated with or without the fuel economizer or the air heater, and with natural draft, induced draft, or forced draft.

The McGill University boiler, (referred to in trials B and D of the table annexed), is of the Robb-Mumford internally fired type, consisting of upper and lower water and steam drums connected by circulating necks. In the lower drum, the axis of which is inclined upwards about 1½ inches per foot of length, is a cylindrical firebox, from which the tubes lead to the rear head of the boiler. On leaving the tubes, the hot gases are passed over the external surfaces of the boiler between the lower and upper drums and inside a steel casing covered with brick. The inclination of the lower shell and a baffle plate around the upper half of the furnace assist in the natural circulation which appears to be unusually brisk. The grate is fitted with rocking bars. The principal dimensions of the boiler are as follows: Lower drum, 68 inches diameter by 15 feet 6 inches long; upper steam drum, 38 inches diameter by 17 feet 9 inches long; furnace, 49 inches diameter by 8 feet 3 inches long; tubes, 2¾ inches internal diameter, by 7 feet 1 inch long, 148 in number; total heating surface (not including the lower surface of the lower shell, which although enclosed is not effective), 1,074 square feet; grate surface, 24½ square feet. The boiler is in regular use in the MacDonald Engineering building at McGill University, and is part of the installation which supplies steam for light, power, and heating purposes. It can be worked either under natural draft or with forced draft on the closed-ash-pit system.

Apparatus Employed.—For both sets of trials at the Ohio and McGill Universities, draft gauges were used to measure the draft and thermometers and pyrometers to take the temperature of the air on entering the ash-pits and the gases leaving the boilers, also for the feed water.

Pressure gauges were used to get the steam pressure, and for the Ohio trials a barrus calorimeter was used to determine the quality of steam. For the McGill trials the steam was taken as dry. For all trials weighing tanks were used for weighing the water, the weighing tanks opening into a collecting tank below from which the water was pumped to the boilers. All steam and hot-water piping was covered with non-conducting material; all fittings were made tight or blanked off to avoid leakage. The fuel was weighed, the time and weight of each barrow load being noted. Samples were taken with each barrow load for the determination of moisture and for calorimetric tests by a Mahler

Calorimeter, for the Ohio trials, and by a Donkin calorimeter for the McGill trials.

Methods Employed in Carrying on the Trials.—For the Ohio University trials (A and C) with brick furnace and setting, the boiler was fired continuously from thirty-six to forty-eight hours before the trial, in order that the brick work should be thoroughly heated. About two hours previous to the commencing of the test proper, the fire was drawn, the damper being closed, grate bars and ash-pit cleaned, and a new fire immediately kindled with the coal to be used. This new fire was converted as quickly as possible to the condition to be maintained throughout the trial, the draft being regulated to give the desired fuel consumption and depth of fire fixed to secure the best consumption with the least amount of air excess. The tubes were blown free of soot after starting the fire. About ten minutes before starting the test proper, the exact time being noted, the last fresh coal was thrown on, and five minutes later, the fire was levelled with a rake and the thickness determined by resting a bar on the bed of fire and levelling it by sighting on the level gauge and then noting the thickness by graduations on the fire door, which was open just enough to allow the rod to pass into the furnace. At the time for starting, the height of water in the boiler drum was noted on a scale reading in one-tenth inches, fastened to the gauge glass, and a string was also put on the glass at the same point, as a guide for the person controlling the feed water to the boilers. All readings were taken at regular intervals of one-half hour, commencing fifteen minutes after the test started. The firing was done at regular intervals of three to five minutes, depending upon the rate of combustion, and the amount fired was usually two shovelfuls. At the end of the trial, the same methods were employed as regards firing, the thickness of fire, etc., as at the beginning, and if the water in the boiler was not the same height by the scale, the necessary correction was made for this, based on the calibration of the boiler drum. The fire was then allowed to burn out, when all refuse was cleaned from the grates and the pit. The trials were conducted by A. J. Boehme, G. R. Bott, and J. S. Wilson, members of the senior class of mechanical engineering for graduation thesis, carried on under the direction of Professor Hitchcock.

For the McGill University trials, (B and D) at the commencement of a trial the fire was allowed to burn down until only just enough was left to light up a fresh fire, the stop valves being manipulated so as to keep the steam pressure constant. At the time of commencing, a known weight of wood (allowed for as half its weight of coal) was fired and firing then began with weighed coal. The fire was opened up as the production of steam increased. The end of the trial was taken to be the time when evaporation ceased, as the last of the weighed coal died down on the grate. Just enough fire was left to light up again. In this way, any uncertainty as to the depth of the fire at the beginning and end of the trial was avoided. The level in the water gauge was the same at the commencement and end in each trial. The trials formed a portion of the regular instruction course in the department of mechanical engineering at McGill College, and were carried out with the boiler at ordinary work, the remaining boilers in the room being steamed so as to take the fluctuations of the load so far as was possible. In no case was special preparation made for the trial, except that the tubes were swept just before the trial began.

Trials of Boilers.

(A and C with brick furnace—B and D internal furnace).

Desig'n of trial.	A	B	C	D
No. of trial (original report)	101 B.E.H.	2	160	3
Date of trial	Feb. 2, '01	Nov. 11, '98	Feb. 12, '02	Nov. 18, '98
Type of boiler	Water-tube	Int'l-furn.	Water-tube	Int'l-furn.
Duration of trial—hours	10	8h. 5m.	9	8h. 22m.
Heating surface—sq. ft.	1,070	1,074	1,070	1,074
Grate surface—sq. ft.	25	24.5	20	24.5

Average Pressures and Temperatures.—

Steam pressure by gauge, lbs. per sq. in.	[illegible]	102.5	[illegible]	[illegible]
Steam temperature, deg. F.	358	339.2	[illegible]	[illegible]
Draft at damper, ins. water	.16	.275	.552	[illegible]
Draft in ash pit, ins. water	-.08	0	.02	[illegible]
Feed water, deg. F.	196	141	53.2	142
Escaping gases, deg. F.	499	427	559	454
Air entering ash pit, deg. F.	158.5	[illegible]	57.9	70
Air used per lb. coal, lbs.	19.41	17.5	[illegible]	18.9

Fuel and water.—

Kind of coal,	George's Creek R. M.	George's Creek, R. M.	Hackers Run Camp	George's Creek, R. M.
Coal consumed per hr.—lbs.	375	344.1	581.4	523
Moisture in coal, per cent.	1.08	1.7	.85	2.2
Ash and refuse in coal, per cent.*	8.9	6.6	10.48	6.8
Coal per sq. ft. grate per hour	14.8	13.23	29.07	21.35
Water evaporated per hour, lbs.	3,262	2,832	4,011	4,234
Factor of evaporation	1.094	1.115	1.203	1.112
Evaporation per hr. from and at 212°	3,569	3,157	4,826	4,708
Evaporation per lb. coal, lbs.	8.69	8.75	6.889	8.09
Equivalent evaporation from and at 212° per lb. of coal—lbs.	9.518	9.75	8.30	9.00

Heat Value of Coal and Efficiency of Boiler and Furnace:

A—Heat used in evaporation. B.T.U.	9,192	9,580	8,016	8,480
B—Calorific value of coal. B.T.U.	14,240	13,900	13,647	13,900
C—Efficiency boiler and furnace, A ÷ B = C = per cent.	64.54	69	58.74	61

Ash and refuse in Coal:

*The percentage of ash and refuse for trials B and D would have been higher if they had been taken from the analysis as they were for trials A and C instead of by weight. (See Prof. Hitchcock's paper, sec. 20), and for this reason the evaporation per pound of combustible is omitted.

Comparison of trials.—Trials A of the external brick-furnace boiler and B of the internal furnace boiler were made under natural or low-pressure draft, and trials C and D of the same boilers under forced draft. All of the trials show the evaporation per pound of coal to be in favor of the internal furnace boiler, and the total efficiency of the two types of boilers and furnaces based on the heat value of the coal, which forms the true test, shows 4.5 per cent. in favor of the internal furnace boiler for natural draft, and 2.25 per cent. for forced draft. It will be noted, however, that the brick-set boiler and furnace was given the following advantages in the trials:—In trial A for the brick furnace with natural draft the air entering the ash pit was preheated to 158.5 degrees F., as compared with cold air at 30 degrees for the internal furnace boiler, trial B. Professor Hitchcock's trials (Numbers 116 and 117) show that preheating the air to about the same extent gives a direct advantage of 2.4 per cent., and an indirect advantage, as indicated by less CO in the escaping gases, of 1.3 per cent. So, it would appear that if the air had been preheated for trial B of the internal furnace boiler it would have shown a total efficiency of 8.2 per cent. better than the brick-set boiler and external furnace.

In the forced-draft trials (C and D) the grate surface was reduced to 20 square feet for the brick furnace and not for the internal furnace. Professor Hitchcock's paper (Sec. 20) shows that the reduced grate surface would give an advantage to the brick furnace through less excess of air.

Loss of Heat of Brick Work When Running Intermittently.—In the trials of the brick-set boilers with ex-

ternal furnace at the Ohio University, it will be noted that the boiler was fired continuously from 36 to 48 hours before the trials, in order that the brick work should be thoroughly heated, and Prof. Hitchcock states in his paper (Sec. 20) that as a result of a series of trials made especially to determine that point, cold brick walls continued to absorb heat for 72 hours, and increased the loss during the trial 8.5 per cent., and he also states that brick-set boilers should be preheated not less than 30 hours before the commencement of a trial in order to give their best results. This shows clearly the advantage of an internally fired boiler in cases where steam is used only during the day time or at intermittent periods, because the internal furnace will give as good efficiency during the first hour of steaming as at any subsequent period. The exact amount of loss in running a brick-set boiler during the day time only is not shown by these trials, but from Professor Hitchcock's results I think it fair to assume it would not be less than 4 to 6 per cent. in favor of the internal furnace.

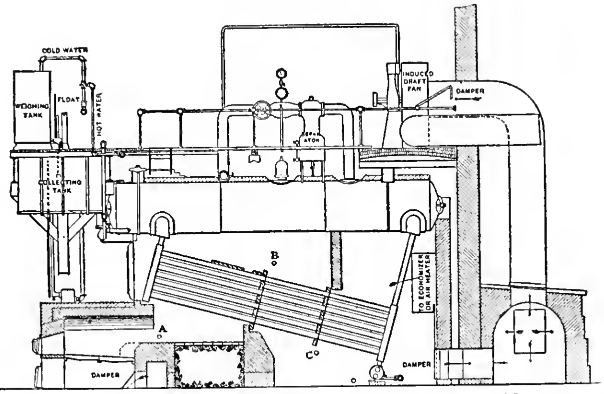


Diagram of Externally Fired Boiler with Dutch Oven Used in Professor Hitchcock's Tests.

It will be noticed in comparing the methods of starting and stopping that Professor Hitchcock used the running start, whereas in the McGill trials, the fire was burned down to the lowest possible point before starting, and also at the end of the trial. While these methods probably give about the same results, Professor Hitchcock's method would be in favor of the boiler, because the condition of his fire would be at its best from start to finish. It would also seem probable that a fire built up even two hours before the start, as was done in the Ohio University trials, might contain a greater amount of combustible matter at the beginning of the trial than at the end, when there would reasonably be a larger accumulation of clinker and incombustible material on the grate.

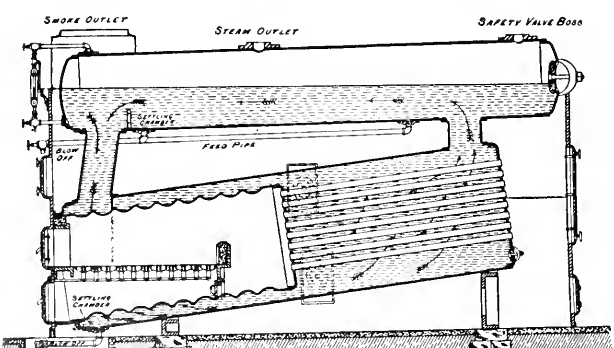


Diagram of Internally Fired Boiler Used in McGill University Tests.

The McGill trials do not show any allowance for moisture in the steam; if we assume that the steam from the boiler contained the same amount of moisture as from the brick-set boiler, we should have to deduct 0.8 per cent. for trial A and 1.7 per cent. for trial C from the results of the internal furnace boiler trials.

To sum up the comparison:—The comparative efficiency of the two types of boilers and furnaces as shown by the trials with the additions for preheated air in trial A, deducting the moisture in the steam, is 7.4 per cent. in favor of the internally fired boiler when the brick setting and furnace is preheated or run continuously; or if run in day time only, say 11 to 13 per cent. in favor of the internal furnace. Under forced draft and continuous running, the difference shown is slightly in favor of the internal furnace boiler, although perhaps not outside the limit of error of testing; but under intermittent running the difference would be considerably in its favor.

It may be said that the differences shown by these trials in favor of the internally fired boiler are within the limits of error of boiler trials conducted by different operators; but taking into account that the firing of the Ohio boiler was done by skilled men, and conducted with a view to getting the best results for the apparatus, while the McGill trials, although carefully conducted, were made with the regular firemen to show the students the methods of testing and the results under ordinary conditions of running; and considering further that the method of starting and stopping the trials at the Ohio University was rather more favorable to the boiler than at McGill—I think the comparison a safe one. But even if the internal boiler did not give any better results than the brick furnace and setting, it would show that the expense in first cost and repairs of a Dutch oven and brick setting are unnecessary; and especially considering the rapid deterioration and increase of air leakage incident to brick work, when subject to the intense heat of combustion, they are objectionable as compared with the internally fired self-contained boiler, which should hold its maximum efficiency in continued service and require much less repairs than the the brick furnace and setting.

—A very interesting lecture on Sewage was given before the Engineers' Club of Toronto, on April 7th, by A. E. Mercer, who has had extended practice in town engineering in the South of England. At the meeting on the 19th, Stanislas Gagne described in an instructive way the process of mechanical pulp manufacturing.

—Achille Michaud, chief engineer of the Government steamer Druid, died suddenly at Quebec.

—The Bruce Carruthers scholarships in mining, at Queen's University, Kingston, were won by D. D. Cairns, Grand Falls, and C. C. Bateman, Kingston.

—May 1st was the sixtieth anniversary of the sending of the first despatch over a telegraph wire by the Morse system. It was sent from Baltimore to Washington. That short stretch of line was the beginning of a system that now comprises 245,000 miles over which last year 91,-391,433 messages were sent.

—The amalgamation of the interests of the New Ontario Steamship Company, the Canadian Lakes and Ocean Company, and Captain Fairgrieve, into the Montreal and Lake Superior Line, has been completed. The six steamers, J. H. Plummer, A. E. Ames, H. M. Pellatt, Arabian, Wahcondah and Neepawa, will call at Toronto, Hamilton and Cleveland, two steamers a week, on the trips between Montreal and Fort William.

John and Daniel Kilgore propose to establish a brick and tile factory at Douglas, in the County of Renfrew, where good clay is to be found in large quantities.

MACHINE SHOP NOTES FROM THE UNITED STATES.

By Chas. S. Gingrich, M.E.

V.

Since sending in my last communication I have had occasion to spend some little time in the machine shop connected with a large printing establishment in Chicago, and was shown a job which I believe will be of special interest in this column, because it is an excellent example of the adaptability of the milling machine, showing, as it does, a case of work done by milling that could not be done economically on shaping or planing machines. It happens that this printing house uses a special metallic backing for electrotypes instead of mounting them on wood, as is usually done. An idea of the nature of these blocks may be gained from the pieces shown at the extreme left of Fig. 3. These pieces are shown with their faces down, and it will be seen that they are cored out so as to make them as light as possible. Whatever may be the advantages to the printer from such an arrangement, it is interesting to us to know that these blocks, which are 4 3-16 in. x 6½ in. long and ¾ in. thick, must be, and are, finished all over, with edges dead square, and the two faces parallel within .001 in., and it is the method by which this is done that I am about to describe. Credit for devising this process is due the Cincinnati Milling Machine Co., who claimed at the outset that the work could be done successfully on one of their No. 3 plain geared-feed millers.

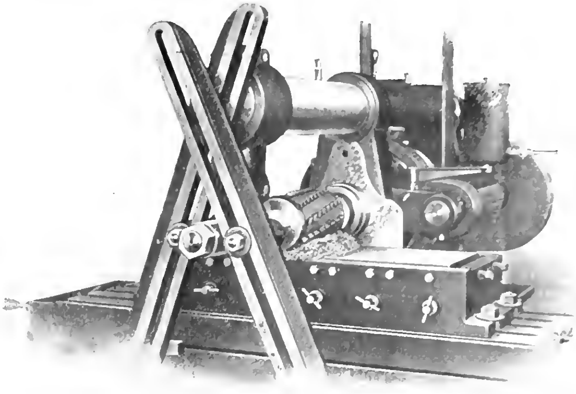


Fig. 1

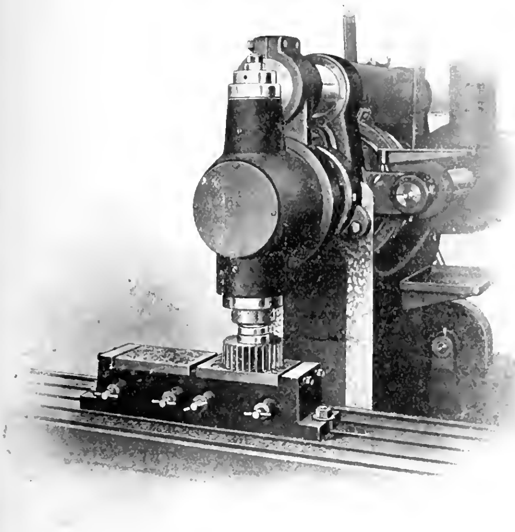


Fig. 2

Fig. 1 shows the miller taking a roughing cut off the pieces, which removes the scale and give an approximately flat surface, so that the pieces can be held in a more accurate fixture, and milled to within a few thousandths of correct size by using the vertical attachment on the miller as shown in Fig. 2. For the third operation, shown in Fig. 3, they are held on a magnetic chuck, and finished to exact size by using a mill having but one cutting edge. And they are [illegible] finished by being again held in a fixture, shown in Fig. 4, in such a manner that two edges are finished at one cut, using side milling cutters in a gang.

The remarkable part of the whole process is that these pieces are finished by the method shown above with a maximum variation of less than .001 in. in the short space of time of 27½ minutes each. The pieces are made in large lots at one time, and each operation is made on all the pieces before a change is made in the cutters and the fixtures on the machine.

It is only when we carefully weigh and consider results like the foregoing that we thoroughly appreciate the revolutionizing influence that the milling machine is having in machine shops. It is now a generally recognized fact that no large machine shop can get along without a miller, and to judge by the rate at which the field of the machine is increasing, it is safe to say that it is only a matter of a few years' time until the manufacturing miller will be considered as indispensable as the manufacturing lathe in every shop.

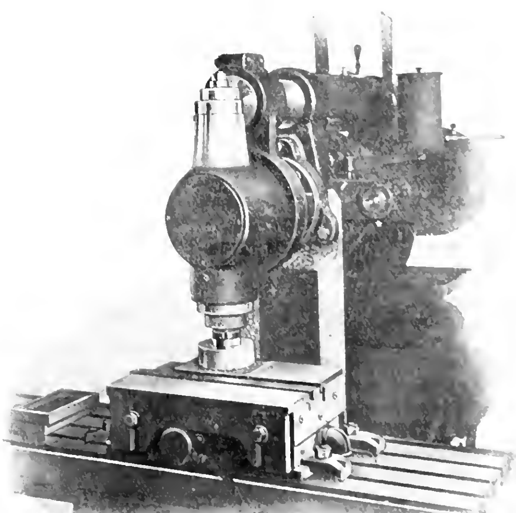


Fig. 3.

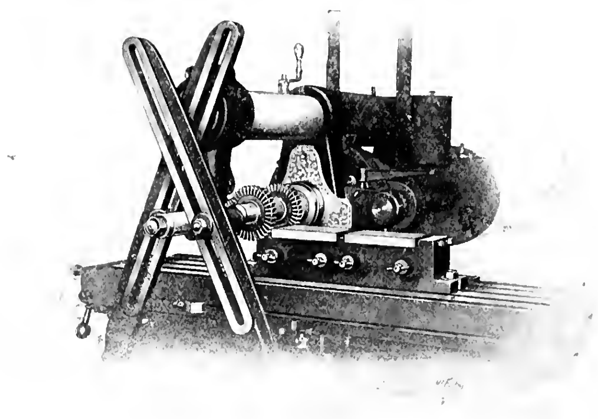


Fig. 4.

MECHANICAL WOOD PULP.*

BY STANISLAS GAGNE, B.A.SC.

At a time when so much emphasis is laid upon Canadian industry and Canadian manufactures, when "Made in Canada" is used as a sign to catch the market of the world, a review of mechanical wood pulp, an industry which not only at present constitutes an important asset in Canadian wealth, but which promises to become almost a monopoly in the future, should be opportune and interesting.

It was the discovery of ground wood pulp as a paper making material in 1845 that first afforded an opening for the growth of this industry in Canada. Mechanical wood pulp is adapted to many other uses besides that of producing paper, but it is as a paper producer that its future is assured, and it is chiefly in this connection that the process will be considered in this paper. Before entering into details, however, upon the process involved in the manufacture of mechanical wood pulp, a sketch of the essential components of paper and of the different materials employed in its manufacture will be given that the efficacy and utility of the mechanical process may be judged by comparison. Typical paper consists of approximately pure cellulose so matted together as to form a sheet.

Cellulose.—Cellulose is termed the material basis for the vegetable world. It is a white, translucent, tasteless, odorless substance without nutritive power, insoluble in water, alcohol and oils, and a little denser than water. For paper making purposes, cellulose fibres are derived from two main sets of sources, in the first place, from cotton and linen rags, esparto, flax (spinners' waste), hemp (old rope), jute, straw and sugar cane; and secondly, from different kinds of wood. In all the fibres derived from these sources the following properties are requisite; they must have a certain length, they must be small in breadth or thickness, they must be flexible and felt well. The felting power depends specially on the structure of the individual fibre. An example of a good felting fibre is the wool (not a paper making fibre, being of animal nature). As seen in figure 1, the wool fibre is discontinuous, consisting apparently of imbricated scales; these brought together tend to interlock, whereas silk fibres (also of animal nature), for example, being dual cylinders, perfectly smooth, simply slide over one another when rubbed or pressed together. We shall now take a short glance at some of the commonest sources of cellulose fibres as enumerated above, and see in what degree they possess these different properties.

Cotton.—Cotton fibres are the purest cellulose available in a natural state. They are long, thin, and rather rough, and when dry tend to roll themselves around their axis, hence they felt well. Figure 2 shows the form and structure of a cotton fibre. These fibres, which usually reach the paper-maker in the form of rags and waste, form the basis of most high grade book papers, and also enter, in different degrees, into the composition of nearly all grades.

Flax.—The fibres of the flax are long, strong and flexible; they are often jointed and cut up, and are capable of lengthening without breaking. They are used by the paper-makers also in the form of rags and spinners' waste, and produce a very strong paper, (linen paper), which, however, is not so compact as that manufactured from cotton. See figure 3.

Hemp.—Hemp fibres resemble very much those of flax, but are coarser and stronger; especially is the pure fibre of Manila hemp which constitutes the basis of the real Manila paper. These fibres usually reach the paper mill in the form of old ropes and rags.

Straw.—The fibres of the straw are little adapted to paper making, but the cheapness of this raw material in such countries as our great west renders its use economical. Straw fibres are of several shapes, some being long and slender and fairly uniform, while some are in the form of smooth pith cells, and of serrated epidermal cells. See figure 4.

Sugar cane.—Cane thrash or bagasse has been recognized as a good raw material for rough paper as its fibres possess great strength. It has been claimed that it is stronger than Manila hemp, but its value for book paper has yet to be demonstrated. As straw it is a very cheap by-product in southern countries.

WOOD.

Most of the above-mentioned sources of cellulose are available only in comparatively small quantities, and as such the paper-makers use them merely to get special grades of paper. On the other hand the great bulk of our manufactured paper is derived from wood. Roughly speaking, wood may be said to be composed of cellulose fibres cemented together. These bundles of cellulose fibres are in the form of long cells which are usually parallel to the longitudinal axis of the tree which cells are also cemented together. See figure 5. The general chemical composition of wood is 50 per cent. carbon, 6 per cent. hydrogen, and 44 per cent. oxygen. Taking poplar and pine as typical examples their physical composition is as follows:

	Pine.	Poplar.
Per cent. of cellulose	53.3	62.8
" " resin	2.0	1.3
" " aqueous ext.	1.2	2.9
" " water	14.5	12.1
" " lignin	30.0	20.9

These quantities vary with different qualities, especially in the case of pine. The following is the percentage of cellulose for different woods:

Poplar	62.8
Silver fir	56.9
Willow	55.7
Birch	55.5
Pine	53.3
Spruce	53.0
Chestnut	52.6
Beech	45.5
Ebony	30.0

The fitness of these different kinds of wood as pulp producers depends somewhat more on other properties than on their percentage of cellulose as will be seen later. Nearly all our Canadian species of wood may be employed for pulp making, but in actual practice the number of kinds is limited; hence we shall consider only those used in our Canadian pulp mills, and more especially those employed by mechani-

*The above paper won the first prize given by the publishers of the Canadian Engineer for the best student's paper presented to the Canadian Society of Civil Engineers for 1903, the judges being members of the Society.

cal wood pulp manufacturers, namely, birch, basswood, poplar or aspen, hemlock, pine, fir or balsam and spruce.

BIRCH.—The fibres of the birch are white, long, and in breadth and thickness vary in different parts of the same fibre; they are, as a rule, pointed and exhibit numerous markings in the form of slits. See figure 6. Only a limited quantity of it is used in Canada, and mostly all by chemical process. It makes a fine grade of paper.

BASSWOOD.—The fibres of the basswood are very similar to those of the birch. They are employed more than birch as a paper producer, and give a fine grade of paper, strong and soft.

POPLAR OR ASPEN.—The fibres of the poplar or aspen are among the best wood fibres for paper making. They are white, long, thin, and pliable, and resemble closely, in appearance, the birch fibres; some show joints and extend in the form of a rail, see figure 7, but they are used for fine book paper, as they are capable of acquiring a fine gloss. They are pulped extensively where a large supply is available, but the difficulty in securing sound wood renders the operation sometimes rather expensive. Poplar and aspen apparently sound to the eye are very frequently, through certain districts, discolored and rotten at the heart. This "black heart" must be removed, as its presence renders the pulp very inferior in quality in proportion to the quantity of the discolored and rotten part.

HEMLOCK.—The hemlock furnishes a coarse and rather brittle fibre of dark color, and suitable only for cheap paper. Generally speaking, it is used only where the supply of other woods becomes short.

PINE.—Pine fibres are brown in color, long, flat and broad, their ends are tapered and are characterized by oblong openings which penetrate through them. This wood is used but in few places, and pulped by chemical process. It produces a brown paper specially well adapted for boxes for sugar confections.

FIR AND BALSAM.—The fibres of the fir or balsam resemble those of the spruce described below, and are, like it white, long, thin, and strong. As found in different parts of Canada, this species contains varying quantities of resin, a fact of much consequence in its value as a pulp producer. Where it contains little resin it ranks near spruce as a raw material, but where resin is present in large quantities, it is detested by the manufacturers. In the chemical process much difficulty is experienced in removing the resin, and in the mechanical process no end of trouble is occasioned by the resin in the various parts of the machinery. Where little resin exists, as much as 25 to 40 per cent. of fir or balsam is used with spruce, and when largely resinous, 5 to 10 per cent. is considered plenty, and none at all much better.

SPRUCE.—The physical composition of spruce, as given at the beginning of the article on wood, shows that it contains 53 per cent. of cellulose fibres, its other constituents resembling those of pine. Its fibres are white, long (from 1-2) to 1-5 of an inch), thin (from 1-500 to 1-2000 of an inch), broad and flat, rough, strong and often twisted. They are characterized by the presence of numerous pitted cells or cups, circular and elliptical; see figures 5, 8 and 9. In Canada we have mainly three kinds of spruce: the black, the white, and the red or grey; these colors refer chiefly to the bark and not necessarily to the wood fibre. The black variety is that which stands in most favor with all pulp manufacturers. Its fibres are the toughest of the three varieties and are fine and white. It grows very thickly in swampy regions, such as the Laurentian areas, where it is easily recognized by its dark bark and long stem, with only a bunch of leaves at the top. The white variety grows specially on dry ground and its fibre is a little weaker than that of black spruce, but somewhat whiter. It also makes a fine grade of pulp. The name grey spruce refers to the color of the bark, and red spruce to the color of the wood. The fibres of red spruce resemble those of the white variety, but have a pinkish color. These three varieties of spruce form the basis of the wood pulp industry of Canada, and in the majority of the mills spruce is employed exclusively, especially for mechanical pulp. They furnish the best wood fibres for paper making and our immense available supply renders them a most economical raw material. It may be added that trees of slower growth produce the longest and toughest fibres; for example, spruce grown on poor soil or in rocky places, or again in cool climate give better fibres than that grown in richer soil and warmer climate. For these reasons spruce grown in Newfoundland or near the Labrador Coast gives a better grade of pulp than that grown farther inland and south. For climatic reasons also, Canadian spruce furnishes better pulp than that grown on the soil of our southern neighbors.

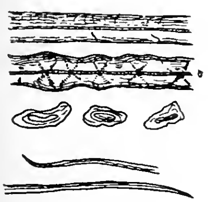


Fig. 3 — Flax Fibres
a shows creasings from bending

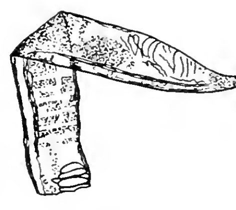


Fig. 6 Birch Fibre

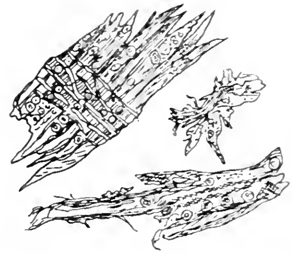


Fig. 9 Ground Spruce

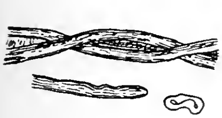


Fig. 2 Cotton Fibre

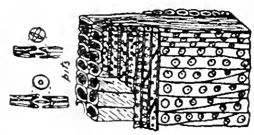


Fig. 5—Spruce Structure

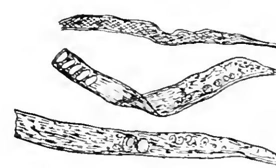


Fig. 8 Spruce Fibres

Fig. 1 Wool Fibre

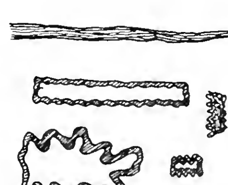


Fig. 4 Straw fibres & cells

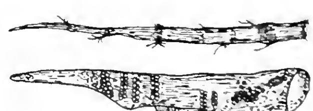


Fig. 7 Poplar Fibres

PROCESSES.

The following is an outline of some of the different processes for obtaining fibrous material or pulp from the above mentioned sources. In all processes, except perhaps the mechanical, the direct aim is to obtain the cellulose fibres pure and individual. Cotton, flax, and hemp are used, as said before, in the form of rags or waste, which are first boiled to cleanse them, then beaten to separate the fibres and bleached. Straw and bagasse are treated by chemical process suited to their composition; they are not pulped in Canada. Wood is treated by two different processes, namely, the chemical and the mechanical. In Canada we have mainly two distinct chemical processes; the alkaline or soda process, and the acid or sulphite process. The action of the chemicals in both cases is to dissolve the non-cellulose constituents or the cementing material of the wood, thus leaving the individual fibres.

SODA PROCESS.—Twenty-five years ago the soda process was considered the most economical of the different chemical processes. It was first developed in America in 1853 by Watt and Burgess; and in 1867, by Angus, Logan & Co., of Windsor, Que., who made soda pulp out of basswood. In this process the wood is first barked and chipped, then packed in digesters which usually consist of cylindrical steel or iron tubes capable of containing 2 to 3 cords of wood; a nine to ten per cent. solution of sodium hydrate is put in and the whole is raised to a high temperature and pressure by admission of live steam. This "cooking" lasts from eight to ten hours, after which the pressure is partly taken off, sufficient only being retained to blow the mixture out in tanks, which is immediately done. This mixture of a brown black color is washed with hot water, and the diluted liquor is conveyed to tanks and washers where the soda is mostly recovered in the form of ash. The pulp then consists of the individual fibre of the wood employed, but colored light brown by the digesting liquor; it is afterwards screened and bleached, preparatory to its being transformed into paper.

All the woods mentioned and described above are or may be treated by this process, but poplar and aspen are the best adapted to it, and in fact they are nearly always pulped thus. This is also a good method for pulping birch and basswood, but spruce, fir and pine are more difficult to treat. Woods are never mixed in the same charge of a digester. The yield of air dried fibres is from 30 to 35 per cent. of the wood employed which shows that from 1-3 to 1-2 of the cellulose has been destroyed.

SULPHITE PROCESS.—The sulphite process is comparatively new, and has several advantages over the soda process which caused most of the mills built lately to adopt it. The advantages are these: the cost of chemicals is less, a larger yield of pulp is obtained, the fibre is not weakened by the process, and the paper made from it is harder and more transparent. In this process the wood is barked and chipped as in the soda process; some manufacturers remove the knots and other impurities which are but little acted upon by the chemicals, while others claim that it is more economical to remove them afterwards in the screens. The chips are dumped into the digester which is an iron clad cylinder, vertical or horizontal, or perhaps also rotary, lined with some material not acted upon by the acid; in the past lead was employed for this purpose, but in later practice, a layer of 4 or 5 inches of portland cement has been found to work well. In a digester of a capacity of 2 cords, 2,500 gallons of a 3½ per cent. solution of an acid sulphite is put in and live steam is turned in thus raising the temperature and pressure. The constitution of the wood tends itself to the formation of certain organic sulphur acid (sulphonates), which greatly facilitate the process. After 10 to 12 hours of "working," the pulp is blown out into the tanks where it is washed; the liquor in this case, however, being usually dumped into the nearest stream, the gases only being preserved. In this case also the pulp consists of the individual fibres, which, after being washed, screened and bleached, are ready for the paper machines. As in the case of the soda process all the woods above described may be "pulped" by this method, but spruce is the best adapted and the most employed. The yield by this process is usually from 40 to 50 per cent. of the wood employed, which is quite an excess over that of the soda process. There are many other so-called chemical processes for isolating cellulose from wood, but as they are not used in Canada, and not likely to be for some time at least, they are of little importance to us.

THE MECHANICAL PROCESS.—In the mechanical process the wood is first cut into 1½ to 2 feet lengths and barked. These blocks are then pressed against revolving sandstones which grind the wood to a pulp. This, again, after being screened and bleached is ready for the paper machines, but as our mechanical pulp is nearly all made for exportation, it has to be transformed into a convenient shape for shipment. For this reason, the mechanical process as usually understood also means the use of "wet machines" to put the pulp into the form of sheets, and also of hydraulic presses to extract the water from these sheets, and of packing presses to put them into proper shape for shipment. The above description of materials and processes has been given to convey a full understanding of the aim and object of pulp making, and to furnish a basis of comparison. We shall now turn our attention to a fuller description of the mechanical process, which is the main object of this paper.

The aim of this process is likewise to produce cellulose fibres for paper making, but being purely mechanical the whole solid substance of the wood except the bark is ground into pulp. As we have seen, spruce for example, contains only 53 per cent. of cellulose fibres, hence mechanical pulp made from spruce can only contain 53 per cent. of paper making fibres, the rest being called the cementing material which is mainly lignin. This is the reason why paper partly made of mechanical wood pulp, such as newspaper, for example, discolors when exposed to the light for some time.

Again, as the wood is ground on stones, we have the pulp in the form of minute chips and not as individual fibres as in the case of the chemical processes. Therefore this process gives a very different result from the others described, which places it in a class by itself. It is not, however, a rival to them; each kind having its own use. It is the direct object of the manufacturer in every case however to get as nearly as possible a fibre pulp, a fact on which depends the value of his product.

WOODS EMPLOYED.—Spruce, especially the black variety, owing to its tough fibre and also for the other reasons mentioned, is mainly employed. Fir or balsam are also used from 5 to even as high as 40 per cent., with spruce as stated. When ground its weight is less than spruce, and consequently more wood is required to produce a ton of pulp, and it is more bulky when baled. When resinous it adheres to the stones, chokes the screens, clogs the cylinder and the felt of the wet machines, causing irregular sheets and general trouble everywhere in the process. Poplar (aspen) when ground makes a fine white and smooth grade of pulp, but as the supply is nearly always limited, its use is also limited. Spruce and poplar or aspen make a good combination, spruce lending its strength and poplar its firmness to the pulp. The methods of cutting and bringing wood to the pulp mills are the same as in the case of ordinary sawmills, the only exception being that all the wood of a tree is utilized save the branches; in some cases logs as small as three inches in diameter are brought to the mill as the size of the blocks is really of not much importance. Figure 10 illustrates the general principles adhered to in the building of a pulp mill. No definite rule is offered for the arrangement of the machines, each individual site having its own peculiarities.

POWER.—All mechanical wood pulp mills in Canada are situated on some water course or stream from which the necessary power is derived, and in most cases, on which the wood is floated to the mills. As a rule steam power cannot be used for this purpose on account of the large amount required as a consequence of the great variations of the load, and its cost. A water fall, natural or artificial, is the only source of power that can be utilized for a pulp mill. An ordinary grinding machine producing 5 tons of pulp (dry) per 24 hours, requires about 350-h.p., and an additional 25 will drive the rest of the machinery for those 5 tons, therefore 75-h.p. are

necessary to produce one ton of pulp (dry) in a day. As it is not the purpose of this paper to discuss the methods of utilizing a water-power, and the means of getting the highest power from a given fall, a few remarks concerning the requirements of the process will be sufficient. A dam or canal, or perhaps both, are built, and from there a penstock, flume or pipe line conveys the water to the turbines or water-wheels. The types of these wheels are governed by the height

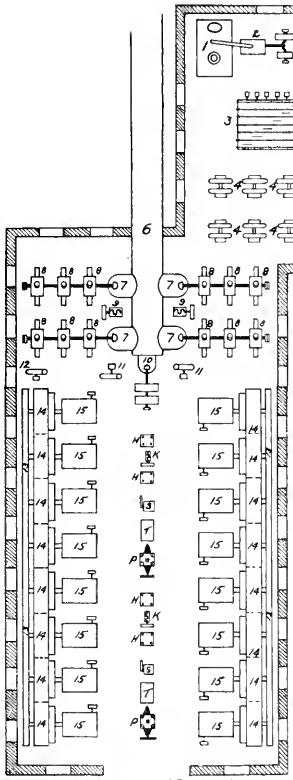


Fig. 10—General Plan of a Mechanical Wood Pulp Mill.

Explanation: 1—Steam Boiler. 2—Steam Engine. 3—Sawing Machine. 4—Barking Machine (in pairs). 5—Splitting Machine. 6—Water Flume. 7—Turbines and Casings for same. 8—Grinding Machines. 9—Pressure Pumps. 11—Casing and Turbine for general work. 11—Stuff Pumps. 12—Low Pressure Pump. 13—Troughs. 14—Screens (vibrating type). 15—Wet Machines. H—Hydraulic Presses. K—High Pressure Pumps. S.—Scales. T Tables. P—Packing Presses.

of the fall (the usual practice being to use reaction turbines for low heads and impulse turbines for high heads) by the variations in the volume of water available and by the work that is expected of them. As will be seen later, some such speed as 175 to 250 R.P.M. is required, and this ought not to vary when part of the load is taken off, as when pockets of the grinders are being filled, thus relieving the pressure on the stone. To attain this result, governors are sometimes employed, especially when wheels drive only one or two grinders each, for then, one pocket opened mehns 1-3 or 1-6 of the load suddenly taken off, and in such cases the turbine will increase in speed according to its construction if no governor is attached to it; but the cost, great wear, frequency of repairs and losses of time, occasioned by these causes most manufacturers to do without them if they possibly can. As will also be seen later, pumps are sometimes used to act as governors, but as their use, as such, means a different grade of pulp at different times they are unsatisfactory for this purpose. The best means of getting over the difficulty seems to be to couple on one pair of turbines, turning both in the same direction relative to their common shaft, as many grinders as possible. If a pair of turbines are thus attached to each other, as in the case of Fig. 10, the friction on the end bearings will be eliminated, thus increasing the efficiency, and if these are made of the largest possible power several grinders are coupled to that pair, and in that case the variation of the load is smaller. In some cases turbines may be built so that variation of speed will be small compared with certain variations of load, thus dispensing with governors. Again turbines may be designed for a given speed when some of the pockets of the grinders are idle, and in operation, when the pressure is relieved from one pocket, the same pressure is automatically applied on another one, thus keeping the load, and thereby the speed constant. Therefore the problem is this: Given a certain head and volume of water, to get a turbine that will give a good efficiency at a given speed, and that speed not to vary much with certain variations of the load. To fulfil these requirements, it does not do to get any turbine whatsoever because of its low prices or other such considerations.

Handling logs.—To maintain proper order in this description of the mechanical process, we shall start with the wood as it arrives near the mill, i.e., where lumbering operations proper end, and follow it through the different parts and machinery of the process. If logs are floated down the river, they are kept in a boom above the mill dam from which they are taken to the cutters by means of a slide, chain conveyor, and log jack, or a similar arrangement depending on the nature of the ground relative to the mill. If brought by cars they are dumped near the mill where some arrangement such as an endless chain distributes them to the cutters. A similar device is used if the logs are brought from the river below the mill or taken from the piles of the winter supply which have been laid on skidways at the fall before the river was frozen. One of the rules that should be observed in handling logs is to keep them out of contact with the ground as much as possible, because sand and dirt will occasion trouble when they are sawn and barked. The wood should also be employed as green and wet as possible, because the grinding operation is thus facilitated and the pulp is of a higher grade as the fibres are more flexible and not so hard to detach from each other.

Sawing.—The logs are cut into lengths regulated by the size of the pockets of the grinders, usually 24 inches, though some use as small as 10-inch lengths. For mills of a small capacity, say up to 30 tons per day, a swing saw is generally

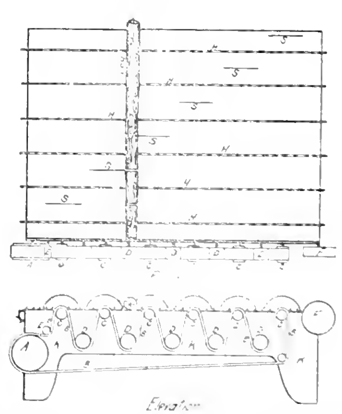


Fig. 11—Principle of a Pulpwood Sawing Machine.

Explanation: A—Driving Pulley. B Driving Belt. C Saw Pulleys. D Tightening Pulleys. E Tightening Pulleys. F Conveyor. K Frame. H Chain Conveyors. S—Saws.

considered a good arrangement, especially when logs are from 10 to 14 feet long. If the logs are brought to the mill in 4-foot lengths (cord length), a cradle saw is sometimes used, where logs are put on a cradle which is swung to the fixed revolving saw. One of the best machines for sawing these blocks, when the mill has a large capacity and output, is that represented by Figure 11. In that case each saw is on a separate shaft and all these saw shafts are driven by the same pulley and belt. Logs are driven across the table by endless chain conveyors, and in this way only one saw is

cutting a log at a time. If more than one saw is made to cut a log at one time, that log is liable to jam beween the saws, damage them and fly out, especially if three saws or more are used. By this method, illustrated in Figure 11, when a log has passed across the whole table, it is all cut up into the required lengths which fall near by, or are conveyed to the barkers.

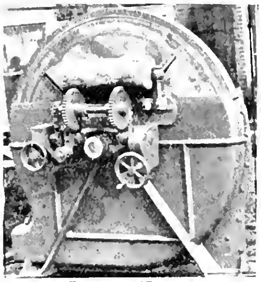


Fig. 14—Pulpwood Barker (Sherbrooke Iron Works.)

BARKING.—The type of barker most frequently employed is that represented by Figure 14. In consists of a disk about 52 inches in diameter in which four knives are so set as to cut a thin slice off the wood stick at a time. That disk is surrounded by a cast iron frame open to give access to the knives, and a table to support the wood is attached to it. The bolt or stick is pressed against the revolving knives and the bark and chips, falling behind the disk, are blown by fans acting like a centrifugal pump, through a pipe to a convenient place, usually to the boiler to be utilized in steam generation. The wood is usually pressed and revolved against the cutting knives, by hand. Various arrangements (such as the one represented in cut), have been invented to revolve the wood automatically against the knives, but the writer is doubtful if such a plan is useful and economical. The speed of revolution of the stick, in these automatic revolving appliances, depending as it does on that of the knives, they ought to do good work and save labor if the bark is of uniform thickness, but in cases where logs are brought long distances by water and through rapids, the

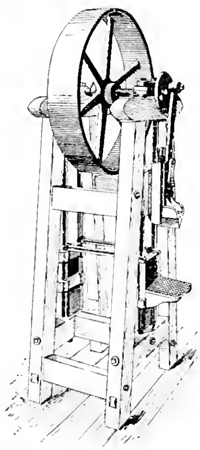


Fig. 16—Wood Splitter.

thickness of the bark is very irregular, and in fact, parts of the stick have no bark at all; hence if these sticks are put into an automatic revolving apparatus some good wood will be cut unnecessarily, whereas if revolved by hand the bark only will be cut away. The capacity of an ordinary barker running at about 600-R.P.M., is usually from six to ten cords a day, varying with the skill of the operator.

SPLITTING.—When sticks are too large to enter conveniently into the pockets of the grinders they are split by hand or by a machine, such as represented in Fig. 16. In these cases, which frequently occur where pulp mills are provided with a carriage and saw for turning large logs into lumber for the market instead of utilizing them to produce pulp, little splitting is required after barking. It is usually found convenient to have the sawing, barking and splitting operations all performed in a separate building, as shown in general plan, Fig. 10. Power for this purpose may be derived from one of the turbines or from a steam engine, the bark and small butts being used as fuel. From the barkers the wood is conveyed to the grinders.

(To be continued.)

GRAIN PRESSURE IN DEEP BINS.*

By J. A. JAMIESON, C.E., MONTREAL.

(Continued from April issue.)

It is quite safe to state that very few engineers would make the mistake of applying the fluid pressure theory to grain or other granular substances stored in deep bins. To do this it is necessary to ignore the well-known fact that strictly granular materials when placed on a level floor, will form a pyramid or cone with sloping sides, at a considerable angle from the horizontal, clearly indicating considerable friction within the mass. It would be also necessary to ignore all the known published data in regard to friction between different solids and granular substances, and also the many structures throughout the country which have been safely used for years for the storage of grain, coal, etc., but which would not stand the tests of fluid pressures.

With a view to showing the difference between designing a bin or series of bins for the storage of grain or for the storage of a fluid, if we take a bin say 12 feet square and 72 feet deep, with a co-efficient of friction between grain and the bin walls of .468 when filled with grain, the vertical pressure will be only 15 per cent. and the horizontal pressure only 9 per cent. of the pressure that would be produced by a fluid of the same specific gravity as grain. Therefore the bin bottom will only require to be 15 per cent. of the strength to carry the vertical load and the walls to resist the horizontal pressure only 9 per cent. of the strength. The walls, however, require to have sufficient strength acting as a column to support over 86 per cent. of the total weight of grain in the bin, while if used for the storage of a fluid, the walls would have no load to carry beyond their own weight. On the other hand it is quite practicable to design and build a tank or standpipe that will have an ample margin of safety when filled with water, and that would undoubtedly fail when used for the storage of grain.

In order to show the importance of the question from a financial standpoint, it may be stated that if the bin structure of the Montreal Harbor Commissioners' elevator was designed and built to safely withstand fluid pressure and at the same time safely carry the grain loads, the cost would be at least $200,000 greater than if designed for the storage of grain with a factor of safety of 4. It would, therefore, seem that in cases where so much money was involved, and when the question of the proper design to meet the requirement of an important link in the transportation problem was at stake, the question would have been worthy of careful investigation. We, therefore, have as the two extremes, tanks apparently designed to hold chaff, and those of the expert fluid pressure theorist, who would have grain storage bins designed to hold water.

In view of the wide divergence of opinion and the lack of accurate published data on which to base calculations for the strength of grain storage bins, the serious losses that have occurred and the consequent lack of confidence caused thereby, the author believes that all engineers and owners interested in grain elevators and the storage and handling of grain, will agree that a full investigation and systematic series of tests to ascertain the manner in which grain loads are carried and the pressures produced by grain, are very urgently required. The author, therefore, proposes to present as clearly and briefly as possible the information gained by con-

*From a paper read before the Canadian Society of Civil Engineers.

ducting a systematic series of tests, calculations, and investigations, to ascertain all possible information on this subject and in order to confirm the tests and deductions therefrom, and will illustrate some of the weaknesses that have developed in different forms of construction. He will also endeavor to show the cause for certain failures, and describe the problems to be met in the safe and economical design of grain bins, and will in connection therewith, illustrate and describe a number of designs of grain bin constructions.

Before proceeding to describe these tests, the author will briefly outline such different tests, calculations and discussions on this subject as it has been possible to obtain from any hitherto published records. In Great Britain in the year 1882, Isaac Roberts made a series of tests on both model and full-sized bins, which demonstrated that in a grain bin having a depth equal to 4½ times the diameter, the proportion of the grain weight resting on the bin bottom was very small, as also the lateral pressure. Mr. Roberts read a paper describing his tests before "The British Association for the Advancement of Science." The author, however, regrets that he has been unable to obtain a full copy of this paper. In 1895, H. A. Janssen, C.E., Bremen, Germany, made a number of experiments on small rectangular bins with a view to obtaining the proportion of weight of the grain contained in a bin that would rest on the bottom, and that would be carried by the bin walls. His bins were all of approximately the same depth but of varying horizontal areas. Briefly, his system of tests consisted in supporting bin walls on four jackscrews while in the bottom of the bin was placed a loosely-fitting board resting on a platform scale. By filling the bin with grain the proportion of weight resting on the bottom was recorded on the scale. When the weight previously placed on the beam balanced the weight of grain resting on the bottom, a record was taken of both the weight of grain in the bin and the proportion of said weight that was resting on the bottom. The bin was then slightly raised by means of the jackscrews, and owing to the friction of the grain on the bin sides this also relieved part of the bottom pressure and allowed the beam to drop; added weights were then placed on the beam and the filling of the bin proceeded with, the same procedure being followed until the bin was filled. Janssen's tests were thus carried out in four different sizes of bins, but were to obtain the bottom pressure only, as he found that having obtained the bottom pressures, it was quite simple to calculate the lateral pressure. By conducting a series of tests to obtain the co-efficient of friction between grain and the bin wall materials, he was enabled with the information thus gained to calculate pressures in different sized bins. His experiments seem to have been very carefully and scientifically carried out, and his apparatus well adapted for the purpose. The results which he obtained are almost identically the same as those obtained by the author.

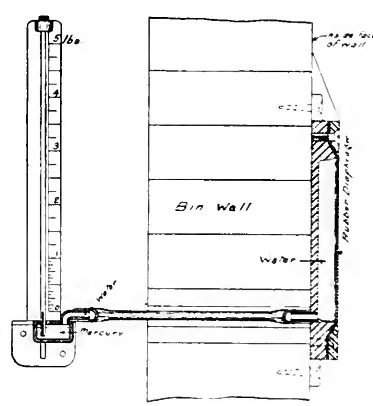
[The author then relates the investigation of Prante, at Bernberg, and of Airy in England, the latter being upon theory only.]

In 1897 the failure of a coal bin in Paterson, N.J., started a discussion in "Engineering News" on the pressures produced by coal and other granular materials stored in shallow bins. This discussion was started by the Editor, and a number of engineers contributed more or less valuable letters on the subject, but no records of actual tests were given, and since the discussion was confined almost entirely to shallow bins there is very little of it applicable to the deep bin problem.

About two years ago, or at the time of the controversy regarding the Montreal Harbor Commissioners' elevator, Dr. H. T. Bovey, C.E., Dean of Applied Science, McGill University, and John Kennedy, C.E., Chief Engineer, Montreal Harbor Commissioners, made a series of tests in the bins of the Canadian Pacific elevator, Montreal, and the Great Northern, Quebec.

At the beginning of the year 1900, it became apparent that wooden elevator construction must soon be replaced by buildings less liable to destruction by fire, and since this would involve entirely different materials of construction, the author realized that more accurate data was required to permit of intelligent and economical design of new construction. He therefore determined to conduct a series of tests with a view to gaining such information. There being no known appliance for making tests, the first and most difficult problem to be met was the design of the testing appliance to make the tests in a full-sized bin which would meet all requirements as to accuracy, decrease as well as increase of pressure due to the movement of the grain, and would record the pressures in different parts of a bin under all working conditions. Several styles of weight scale-levers and beams were first designed, all of which were open to serious objection and the difficulty seemed unsurmountable until the author conceived the idea of using a hydraulic diaphragm and a mercury or water column gauge, the first of which could be placed inside the bin at any given point either on the sides or bottom, with a tube leading through a small hole in the wall to the gauge, and therefore ascertain the pressure per square inch either vertically or laterally at any point of the bin. This appliance was immediately designed, care being taken to get the pressure face of the diaphragm, which was made of pure sheet rubber as large as practical, so that there would be no receding of the face by displacement of the water, owing to the pressure raising the mercury in the small gauge glass. When this appliance was manufactured and tested, it was found to be an accurate and sensitive weighing machine, and it is believed that no more suitable or accurate testing gauge can be found for the purpose. (See illustration.)

On the 10th of April, 1900, and following days the tests were carried out in the full-sized bins of the Canadian Pacific Elevator, at West St. John, N.B., the inside dimensions of the bin being 12-ft. by 13-ft. and depth above the hopper bottom 67-ft. 6-in.; the grain being used was Manitoba wheat, weighing 49.4 pounds per cubic foot. The hopper bottom of the bin was first filled with grain and levelled off. To obtain the lateral pressure the diaphragms were then placed in position against the walls a short distance above the hopper bottom, with the face vertical, and on top of a small platform attached to the hopper bottom with face horizontal, to obtain the vertical pressure. The gauges were set up in an adjoining bin, a small rubber tube forming the



Grain Pressure Tests—Hydraulic Pressure Diaphragm and Mercury Pressure Gauge.

connection between the diaphragm and the mercury cup of the gauge, the diaphragm and tube being completely filled with water. The grain was then weighed and run into the bin in the usual manner, the first draft having a clear drop of 70 ft. Each draft weighed 30,000 pounds and gave a depth of 3-ft. 9-in. in the bin. The gauge was closely observed as the grain was running in, and the maximum readings taken and recorded as each draft was complete, until the bin was filled. The gauges and the grain were then allowed to remain for about eighteen hours, at the expiration of which time there was practically no change in the reading of the gauge. The grain was then drawn out of the bin and the gauge closely observed and the readings recorded as each 30,000 pounds were weighed out, the maximum readings dur-

ing the draft being taken. The grain was drawn off at the rate of 9,000 bushels per hour. The pressures fluctuated considerably as the grain was being drawn out with a maximum increase of 4 per cent. over that obtained when filling the bin or when the grain was at rest. The position of the diaphragm was then changed to near the corner of the bin and the above procedure repeated with practically the same readings as in the first test. During the running out test, the valve was suddenly closed several times, stopping the downward movement of the grain; this gave a slight increase of pressure, and when the valve was again opened a corresponding decrease of pressure. The pressures obtained both vertical and lateral were then plotted, the maximum readings of the different tests being used. The plottings and curves obtained are shown in the accompanying diagram, plate No. 5, and the pressure per square inch both on the bin bottom and against the walls are given in the accompanying tables, which also show the total side pressure, the relative vertical and lateral pressures and the co-efficient of friction between grain and walls. The column of "Equivalent Fluid Pressure" shows the pressure that would be produced by a fluid of the same specific gravity as the grain due to the different heads, or in other words, the pressures which would exist if there was no friction between the grain and the bin walls.

GRAIN PRESSURE TESTS.

Wheat.—Cribbed Wooden Bin.—Bottom Pressure Tests, Canadian Pacific Railway Elevator, St. John, N.B.

Inside dimensions of bin 12 ft. by 13 ft. 6 in. = 23,328 sq. inches. Depth of bin, 67 ft. 6 in. Each draft weighed into bin = 30,000 lbs. = 3 ft. 9 in. high. Wheat used for test, No. 1 hard Manitoba, weighing 49.4 lbs. per cub. ft. Total grain above diaphragm, 540,000 lbs. To fill hopper bottom, 16,500 lbs. = 556,500 lbs. = Total weight of grain weighed into bin.

Grain weighed into bin.	Height of grain column.		Pressure of grain on diaphragm.	Grain carried on bottom. Weight	% total weight. grain.	Grain carried on bin sides. Weight.	% total weight graint
lbs.	ft.	in.	lbs.	lbs.		lbs.	
30.000	3	9	1.118	26,081	86.9	3,919	13.1
60,000	7	6	1.948	45,443	75.7	14,557	24.3
90,000	11	3	2.499	58.297	64.7	31.704	35.3
120,000	15	0	2,927	68,291	56.9	51.719	43.1
150,000	18	9	3.247	75.746	50.4	74,254	49.6
180,000	22	6	3.482	81,228	45.1	98,772	54.9
210.000	26	3	3.635	84.797	40.3	125,203	59.7
240,000	30	0	3.752	87.527	36.4	152.473	63.6
270,000	33	9	3.843	89,650	33.2	180,350	66.8
300,000	37	6	3.924	91,539	30.5	208,461	69.5
330,000	41	3	3.987	93,009	28.1	236.991	71.9
360,000	45	0	4.041	94.268	26.1	265.732	73.9
390,000	48	9	4.077	95,108	24.3	294,892	75.7
420,000	52	6	4.095	95.528	22.7	324.472	77.3
450.000	56	3	4.113	95.948	21.3	354,052	78.7
480,000	60	0	4,129	96,321	20.1	383.679	79.9
510,000	63	9	4,129	96,321	18.8	413,679	81.2
540,000	67	6	4.129	96,321	17.8	443.679	82.2

Carried on bottom 96.321 on sides 443,679 lbs.
In hopper 16,500

Total carried by bottom = 112,821 lbs.
Total carried by sides = 443,679 lbs.

Total grain in bins = 556,500 lbs.

GRAIN PRESSURE TESTS.

Wheat.—Cribbed Wooden Bin.—Side Pressure Tests.

Inside dimensions of bin 12 ft. by 13 ft. 6 in. = 23,328 sq. inches. Depth of bin 67 ft. 6 in. = 18 sections = 3 ft. 9 in. high. Wheat weighing 49.4 lbs. per bushel. Each section of grain column in bin = 3 ft. 9 in. high, weighing 30,000 lbs. Combined area of four sides of bin = 27,540 sq. inches.

Grain weighed into bin.	Height of grain column.		Equivalent fluid pressure.	Side pressure of grain on diaphragm.	Side pressure per section.
lbs.	ft.	in.	lbs.	lbs. per sq. inch.	lbs.
30,000	3	9	1.286	0.343	9,446,220
60,000	7	6	2.573	0.938	25,832,520
90,000	11	3	3.859	1,317	36,270,180
120,000	15	0	5.145	1.615	44,477,100
150,000	18	9	6.431	1.804	48,682,160
180,000	22	6	7,718	2.011	55,382,940
210,000	26	3	9.004	2.111	58.136,940
240,000	30	0	10.290	2.201	60,615,540
270,000	33	9	11.576	2.278	62,736.120
300,000	37	6	12,863	2.345	63,581.300
330,000	41	3	14.149	2.381	65,672.740
360,000	45	0	15.435	2.417	66,564.180
390,000	48	9	16.721	2.435	67,059.900
420,000	52	6	18,008	2.453	67,555.620
450,000	56	3	19.294	2.453	67,555.620
480,000	60	0	20.580	2.453	67,555,620
510,000	63	9	21.866	2.462	67,803.480
540,000	67	6	23.153	2.462	67,803.480

Total side pressure 1,004,631.660

RELATIVE VERTICAL AND LATERAL PRESSURE.

(See bottom Pressure Table). Pressure on bottom due to 67′ 6″ grain = 4.129 lbs. per sq. inch × area of bottom, 23.328 sq. ins. = 96,321 lbs.

Maximum pressure on side of bin due to 67′ 6″ grain = 2.462 lbs. per sq. in.

$$\frac{\text{Vertical pressure} = 4.129}{\text{Lateral pressure} = 2.362} = 59.6\% \text{ of vertical pressure, or vertical pressure} = 1.66\% \text{ of lateral pressure.}$$

$$\text{Co-effic. of friction between Grain and sides bin} = \frac{\text{W. carried by sides} = 443.679 \text{ lbs.}}{\text{Total side pressure} = 1,004,632 \text{ lbs.}} = .441$$

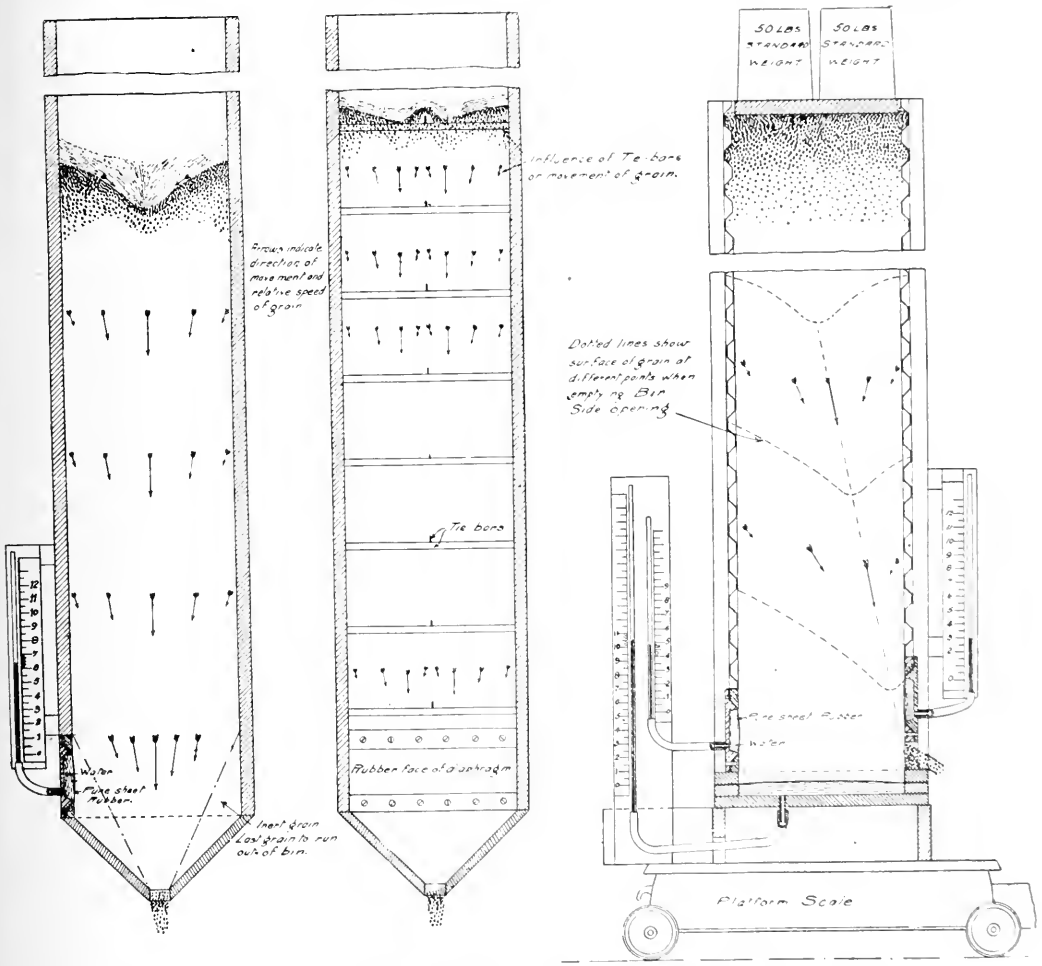
To get further data the author conducted a series of tests in model bins, in the winter of 1902-3. Of the several bins one had sides made of corrugated or trough plate steel, the corrugations running horizontally and attached to corner columns; one was made of smooth wood boards; one of the same dimensions as the last with the boards roughened on the inside of the bin, to imitate a bin of ordinary wooden cribbed construction; one was also lined with flat steel plates to imitate a square steel bin. These were each 12 inches square and 6 feet 6 inches deep. Two were round steel bins, each 6 inches diameter, and 6 feet 6 inches deep. There were six hydraulic diaphragms: One being 12 inches square, one 12 inches in diameter, one 6 inches square, one 6 inches in diameter, one rectangular 3 x 12 inches, and one 2 inches square.

In testing for bottom pressure the diaphragms were the full size of the different bins, forming a complete bottom for them. The total weight of grain coming on the bottom therefore rested directly upon a thin sheet of pure rubber, which in turn rested on the water contained in the diaphragm, while the bin itself rested upon the frame of the diaphragm. Connection as made between the diaphragm and the glass gauge column by a rubber tube, which was set vertically alongside of a measuring scale. To obtain the lateral pressure the diaphragm was made to form part of the bin wall, the face being set vertical and in line with the inside face of the bin. The whole apparatus was set on a platform scale so that the weight of grain could be accurately taken as the bin was filled. The measuring scale was then adjusted accurately to the height of water in the gauge glass. Grain was then poured into the top of the bin in drafts varying from 25 to 6¼ pounds each, according to the size of the bin used, and readings of the height of water column in the gauges taken and recorded at each draft as the bin was filled. Tests for bottom or vertical pressure were made in all the different bins, and for lateral pressure in a majority of the bins. In the square trough plate, or corrugated steel bin, tests were made with the following varieties of grain, viz.:—Wheat, peas, corn or maize, and flax-seed; and in the cylindrical bin, tests were made with thoroughly dry, clean river sand. The grain used was the highest grade that could be procured and was thoroughly clean and commercially dry. The wheat was No. 1 Manitoba Hard, weighing 50 lbs. per cubic foot; peas weighed 50 lbs.;

corn 45 lbs., and flax-seed 41.5 lbs. The sand weighed 100 lbs. per cubic foot. The weights as above were all carefully ascertained by means of the Grain Testers' Balance. Wheat was used to conduct the full series of tests, while the other grains were only tested in two of the bins, with a view to establishing the comparative pressures with wheat, over 50 separate tests being made in full. The tests were all carried out in duplicate. After the first series were completed, the readings plotted and calculations extended, the second series were undertaken with a view to checking the first, and to gain such additional information as was found to be desirable. In the first series the grain was poured into the bin from a pail, while in the second series of tests a funnel with a large opening was used. This did not make any difference in the maximum pressures obtained, but the latter mode of filling the bin gave very accurate curves when plotting the diagrams, while the plottings from the first series were in some instances somewhat erratic. With a view to ascertaining the effect of vibrations or shocks on the pressures, the sides of the bin were sharply tapped with a hammer. It was found that by tapping the bin near the bottom only, the pressure or load on the bottom could be decreased. This was found to be due to a slight deflection in the bin sides, which, however, was not sufficient to allow the grain in the upper part of the bin to settle down. When, however, the tapping was continued from the bottom to the top of the bin on all sides, the grain in the bin could be settled from 2 to 3 inches, giving a slightly increased pressure on the bottom.

In test No. 1A, the full records of which are here given, it will be noted that the settling of the grain amounted to 2¼ inches, giving a maximum reading of 10½ inches of water, or an increase due to the shock of 1¾ inches of water, equal to total increased weight on bottom of approximately 9 lbs. or less than 3 per cent. It may be stated that this shock was proportionately very much greater than could be procured under ordinary conditions in large elevator bins.

(To be continued.)



Grain Pressure in Deep Bins—Model Bins, Showing Position of Diaphragms Grain Running Out.

MINERAL PRODUCTION OF ONTARIO.

The following figures of the mineral production of Ontario for 1903 are from the report of T. W. Gibson, director of the Bureau of Mines.

The values of all the items in the metallic list are lower except nickel, copper and zinc ore, but the chief reduction was in steel, which fell from $1,010,031 to $304,580. The large output of 1902 was due to the fact that the Algoma Steel Works were in operation for part of that year, while in 1903 they remained closed throughout, and consequently the production of steel fell to about the former level.

Iron ore exhibits a diminished yield both in quantity and value, the output in 1903 being 208,154 tons, worth $450,099, as compared with 350,288 tons, worth $518,445, in 1902. This reduction was also one effect of the paralysis which fell upon the great industries at Sault Ste. Marie, and which led to the

closing of the Helen iron mine before the shipping season was over.

The blast furnaces of the province turned out 87,004 tons, or 25,083 tons of pig iron less in 1903 than in 1902. Of the iron ore smelted into pig iron, 32 per cent. came from Ontario mines and 68 per cent. was imported from the United States.

The yield of gold was $188,036, or a decrease of $41,792.

The production of copper (in ore and matte), was valued at $716,726, which was greater in 1902 by 471 tons, the increase in value being $36,643. The chief source of copper remains the nickel-copper mines of Sudbury, but the purely copper ores of the Massey Station mine are now being smelted, and ore is also being raised at the Superior and Tip-top mines.

The output of nickel was larger last year than ever before, exceeding that for 1902 by 1,053 tons in quantity and $288,107 in value. The production of 6,998 tons of nickel, valued at $2,499,068, constitutes a record, and undoubtedly confers upon the Sudbury district the distinction of being the chief source of the world's supply of this metal. As usual, the Canadian Copper Company was the principal producer. The reduction works of this company are at present being extensively overhauled and remodelled, with the view of producing high-grade matte by the Bessemer process. Other concerns contributing to the total were the Mond Nickel Company and the Lake Superior Power Company.

Lead reappears in the tables for the first time in many years, a small furnace having gone into experimental operation near Bannockburn, in Hastings County, about the close of the year, and producing $1,500 worth. Some molybdenite was also raised in the same county.

The substances comprised in the non-metallic list show in some cases considerable fluctuations from the level of 1902, but the footing-up renders apparent an increase on the whole of about 7 per cent.

Carbide of calcium gained 1,105 tons in quantity and $54,580 in value, the output for 1903 being 2,507 tons valued at $144,000. This shows the growing popularity of lighting by acetylene gas, notwithstanding some mishaps which resulted from its use during the year.

There was a small gain in corundum, which is of abundant occurrence in Hastings and Renfrew counties. The output was 849 tons, worth $84,900, of grain corundum, and 270 tons of cobbed worth $2,700. Two companies are now producing the crushed and sized article, with prospects of a third. The pioneer concern, the Canada Corundum Company, is erecting and equipping a new plant of much greater capacity than its old one.

Feldspar was in good demand, and the shipments for 1903 were in excess of those for 1902 by 6,520 tons in weight and $7,171 in value. It is all exported to the United States, where it is used in the manufacture of pottery, and for glazing tiles, baths, enamelled ware, etc.

There were raised 7,469 tons pyrites, principally in Hastings County, or 3,098 more than in 1902, and the aggregate production was greater in value by $6,700. The output is sent to United States markets, principally Buffalo and Cleveland, for the manufacture of sulphuric acid.

The yield of mica, as returned to the Bureau, was 948 tons worth $102,205, or almost exactly the same as in 1902. The production of this article is now confined, more largely than formerly, to companies working on an extensive scale; and since the introduction of micanite, in which the smaller sizes are utilized, the demand is not so much for size as for quality.

The value of natural gas produced last year was valued at $196,535, very little less than in 1902. Much the larger proportion now comes from the Welland field, that in Essex County being practically abandoned. A pool at Dunnville, in Haldimand, is being exploited, and gas is also now being taken from the White Medina formation at Brantford.

Petroleum, of which the Lambton County oil fields remain the chief source, is steadily declining in point of yield. Compared with 1902, the production of crude for 1903 was 1,545,254 imperial gallons less, while compared with 1893 it was 17,414,662 gallons less. In ten years, therefore, the quantity of crude product has fallen off over 50 per cent. The higher prices which prevailed last year, however, prevented the value falling with the production; indeed, there was a marked increase, taking as a basis petroleum products and crude petroleum used for gas and fuel, amounting to $155,620. It is a legitimate subject of enquiry whether there are not yet undiscovered reservoirs of both petroleum and gas in this province. The supply of the former has, heretofore, been taken wholly from the limestones of the Corniferous formation, in which it is found at a depth of about 470 feet from the surface. Borings have been made to the Trenton, but without much success; recently, however, oil has been found in considerable quantity in the southwest corner of Kent County at a depth of 1,290 or 1,300 feet, in what is believed to be the Guelph formation, and more recently still at Brantford, oil has been struck in the White Medina, between 500 and 600 feet below the surface.

Salt continues to be raised in about the same quantity from year to year from the widespread beds lying east of Lakes Huron and St. Clair. In 1903 the output was 58,272 tons, worth $388,097, somewhat less in quantity and greater in value than in 1902.

In building and construction materials, lime and stone both show a decrease in value, the former of $175,000 and the latter of $97,000. These losses are largely offset by an increase in the value of brick amounting to $175,000, the result of active building operations in many centres. There was a further expansion in the quantity and value of cement manufactured in 1903, as compared with the previous year. Natural rock cement increased in quantity by 12,249 barrels and in value by $18,524, while Portland cement showed gains respectively of 172,361 barrels and $266,578. The development of the Portland cement industry in Ontario since its commencement in 1901 has been remarkable. In that year 2,033 barrels were made worth $5,082; in 1894 the output was 30,580 barrels valued at $61,060; in 1897 it was 96,825 barrels worth $170,302; in 1900, 306,726 barrels worth $598,021, and in 1903, 695,260 barrels valued at $1,182,799. Few industries can show a record equal in rapidity and steadiness of growth. The cheapness of cement and the multifarious uses to which it is now being put, ousting as it is to a greater or less extent, lime, brick, stone and wood, have led to an enormous demand. This in turn has called into being an industry fast attaining high rank in value of output and amount of invested capital. There were nine producing plants in 1903, five others were approaching completion and will probably place their product on the market during the present year, and one or more companies are in process of organization. The market in Canada is, however, not unlimited in extent, and imported cement, mainly from the United States, is competing severely with the native article at the present time. It would be a pity to overdo the cement business, and there are not wanting signs that the point to which expansion can for the time being profitably or safely go, has been reached, if not passed.

The only other substance which calls for special mention is peat fuel, of which some 1,100 tons were manufactured by two separate plants last year. The product has given satisfaction, and a larger production may be expected. It is to be hoped that ere long peat fuel from Ontario bogs will largely replace anthracite, imported from Pennsylvania, in the kitchen ranges of the province—a use for which it is eminently fitted.

The ton used is the statutory ton of 2,000 lbs. Values have been computed at the selling price at point of production.

INVENTION OF THE TELEPHONE.

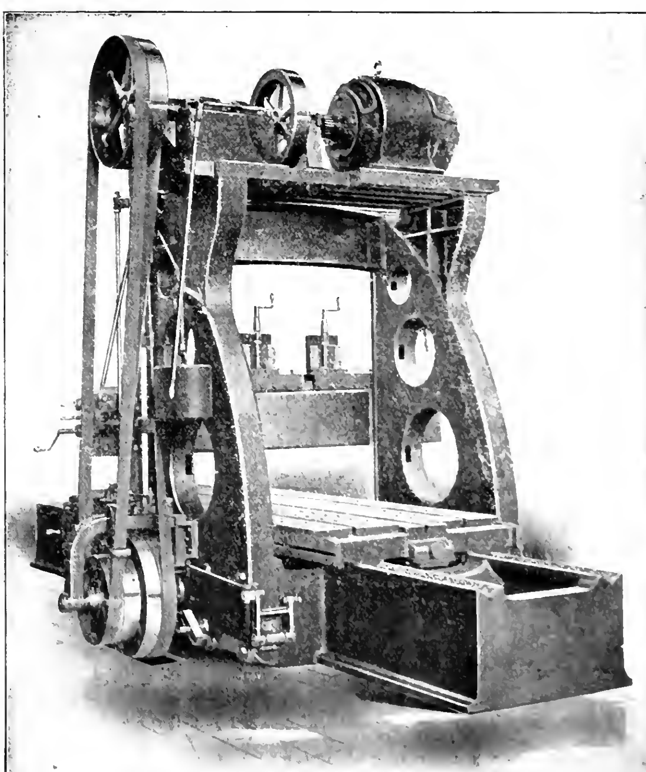
The summer of 1904 will mark the thirtieth anniversary of the invention of the telephone. The Brantford Board of Trade has been in communication with Prof. Graham Bell, the inventor, and in a letter he states the following facts:

"Now it so happens that the telephone was invented in Brantford during my visit to my father and my mother

in 1874. Up to June, 1876, only laboratory experiments had been made with the instruments, and the transmission of speech was from one room to another in the same building. The first transmission of speech over a real telegraph line was effected in Brantford in the autumn of 1876, on the lines of the Dominion Telegraph Company, by means of instruments which I had brought from Boston. In one experiment speech was transmitted from Brantford to Mt. Pleasant, in another from Brantford to Paris, and in a third from Brantford to my father's house on Tutela Heights, where the results were witnessed by a large company of Brantford people. These experiments were made August 10th, 11th, and 12th, 1876, according to an account published in the Toronto Globe and quoted by the Scientific American of September 9th, 1876. In these experiments the transmission was effected only in one direction, the instruments employed not being well adapted for reciprocal communication. As to citizenship, I was born in Edinburgh, Scotland, and was, therefore, a British subject by birth. I landed in Canada from Great Britain on the 1st of August, 1870, and after a few days spent in Paris, Ont., I removed to Brantford, where I resided with my parents at Tutela Heights until March, 1871. The telephone was invented in Brantford in the summer of 1874. . . During the whole period of the development of the telephone, therefore, my political status was that of a British subject, who had taken out his first papers of naturalization in the United States, and who, although not a full citizen, was entitled to the rights and privileges of citizenship. The telephone went into commercial use in 1877. We now have more than three million miles in use in the United States."

FORTY-TWO-INCH HEAVY PATTERN CINCINNATI PLANER.

The accompanying illustration shows a new 42-in. heavy pattern planer, made by the Cincinnati Planer Co., Cincinnati, O. The bed is of the modern deep pattern, resting direct upon the foundation, and is thoroughly braced throughout by the box girders. The V's are wide, and fitted with automatic roller oiling devices. The table has their dirt-proof feature, and is so designed that the rack is extended at each end permitting of a longer piece being planed than the stated capacity of the machine. Complete shafting mechanism is furnished on both sides. The housings are of the popular box form, securely bolted to the sides of the bed and are of such proportion as to insure the greatest stiffness. The cross rail is accurately fitted to the housings, and strengthened by an arch-shaped brace on the back. It is made of sufficient length to admit of an extra head being attached at any time, allowing either head to have full traverse across the table. Provisions are made for raising and lowering it by power. The heads are carefully fitted to the rail, and are graduated for swiveling and provided with automatic feeds in all directions. They can be operated from either end of the cross rail. The down feed screws are provided with micrometer adjustment and ball bearings. Side heads can be furnished on one or both housings, with independent power and hand vertical feed, and can be run below the top of table when not in use. The handles, which control the feeds, travel up and down with the heads, always convenient to the operator. The combination friction is a new feature in planers, insuring positive feed when heads are taking their heaviest cuts. The shifter is [illegible] the table reverses without shock or jar [illegible] able noise of the belts is obviated. It is also provided with a safety locking device, preventing the table [illegible] except at the will of the operator. The rear dog is [illegible] with a latch, so the table can be run from under the [illegible] tool when desired. The driving shafts are made of special crucible steel, accurately ground, and run in long boxes fitted into bored holes in the bed. This construction provides the best facilities for lubrication and makes it possible to remove any shaft with gears intact. The gearing is very powerful, cut from solid stock and all placed on the inside of the bed. The rack is also cut from the solid, is of extra width, and is bolted and pinned to the table in short sections. The countershaft is fitted with self-oiling patent adjustable hangers.



42" Cincinnati Planer

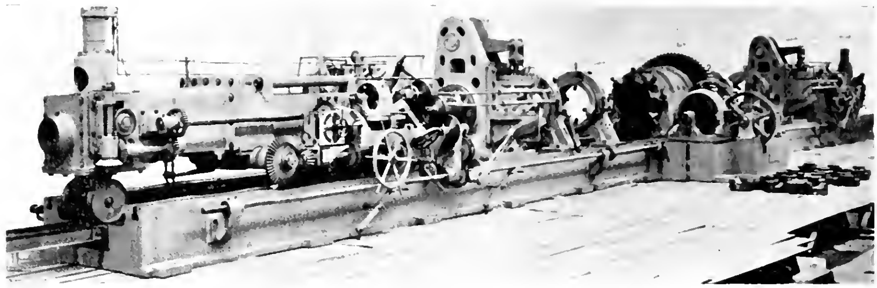
FOURTEEN-INCH HYDRAULIC BORING LATHE.

The machine illustrated herewith is intended to bore gun forgings, marine shafts and ingots generally. It will take in a shaft 60 feet long, 30 inches in diameter, and bore a hole out of the solid 12 inches in diameter the full length, or 14 inches for short length. Two boring bars are used, one at each end, while the work is being held in a hollow spindle or revolving chuck. Two revolving steady rests on each side of the centre chuck support the work. The feed pressure required to do such extremely heavy work is so great that it becomes impractical to feed by rack and pinion or screws. For this reason the boring-bars are fed in by hydraulic pressure. The boring-bar itself is clamped in a head by means of hydraulic pressure, in addition to lever and toggle joint. The hydraulic pressure against the piston is 720 lbs. per square inch, giving a total pressure of 200,000 lbs. against the piston. It is obvious that an arrangement like this would allow the tool to gouge into the work should the metal be soft, and, generally speaking, would not

offer any means of control of the feed. In order to provide for this control, the rear end of the piston, that is, the end projecting backward from the cylinder, is cut as a very steep screw. A nut revolving on this screw has a worm-wheel with very steep pitch cut on its outer circumference. The angles of the screw and the worm are so chosen that the pressure against the piston will be able to revolve the nut, and the movement of the nut will be able to revolve the worm, but a relatively small amount of resistance on the worm will entirely check this movement. This amount of resistance is provided by ordinary feed mechanism taken from friction discs, which have the necessary change-gears, etc., to enable the operator to get any feed desired. It will be seen, therefore, that the hydraulic cylinder furnishes the pressure and the feed mechanism furnishes the amount of feed, but that the feed mechanism is never subjected to the heavy strains due to the exceedingly heavy work to be done on this machine.

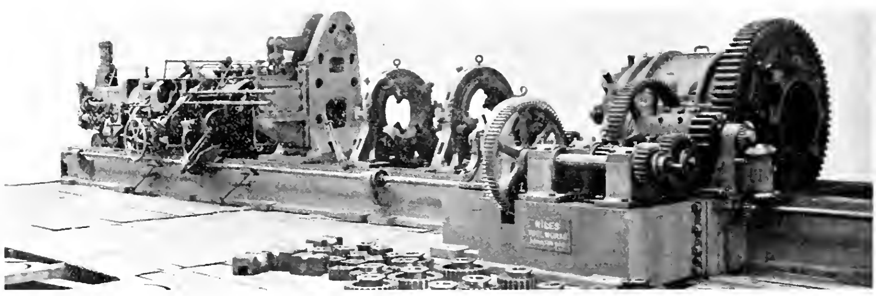
The illustration clearly shows the drive of this machine. It is driven by a 100-h.p. Westinghouse motor, 220 volts. A motor of this make and size always allows of some speed variation by means of field control. The range of speed is increased by change-gears, which are also clearly visible in the illustration. The main driving gear, which is bolted on to the hollow spindle or chuck, has 75 teeth, 4 inches pitch, 10 inches face. It is a steel casting, as is also the spindle. The piece to be bored is chucked by means of set-screws, shown in the illustration. There are eight set-screws, 3½ in. in diameter on each side of the machine. The feed is taken from the last driving-shaft, and is transmitted to the two cylinders by means of the long shaft running alongside and in front of the bed. This shaft is supported by drop-bearings and is made in three pieces coupled together. Change-gears and friction discs give a wide range of feeds. A hand feed is provided for by means of hand wheel. Before using this hand wheel, friction discs and feed driving-shaft are disconnected by means of hand wheel. A 5-h.p. motor gives a fast motion to a train of gearing, whereas the feed mechanism gives a slow motion to this train. Clutch lever throws in either one or the other, and thus gives either a slow feed or a quick traverse of 10 feet per minute to the piston, and, if the cylinder is clamped to the bed, also to the clamping-head, or, if the clamping-head is clamped to the bed, it gives this quick traverse to the cylinder. This quick traverse is really gotten by means of hydraulic pressure in the cylinder, and the small motor only regulates the speed. A hand wheel gives adjustment to the piston and clamping-head, or to the cylinder should this latter be clamped to the bed.

The parts to be moved being very heavy, it is natural that a great amount of movement of the hand wheel is required in order to produce a small amount of motion of either the clamping-head or cylinder, and, consequently, if the cylinder is travelling at a rate of 10 feet a minute by power, this hand wheel would race at a terrific speed, which would be dangerous to the operator. For this reason, the arrangement of the hand wheel is made in such a way that this hand wheel is loose on its shaft or stud if either the quick traverse or feed is thrown in, and is only connected to the mechanism which moves the cylinder when both feed and quick traverse are out of action, thus avoiding all possibilities of danger.



Niles-Bement-Pond Co.'s Hydraulic Boring Lathe.

The train of gearing moved by the motor can be connected to the cylinder mechanism, or it can be connected to the shaft, which, by means of suitable gearing, drives a grooved roll, which is not visible in the illustration, but which is held in a floating frame inside of the rear part of the cylinder casting. This floating frame carries the hydraulic cylinder, the piston of which is connected to this grooved roll while the cylinder casting is connected to two other rollers under the bar. By admitting water in this cylinder the inner boring-bar is clamped between the rollers, and by moving the grooved roll in a quick traverse, motion is imparted to this inner bar.



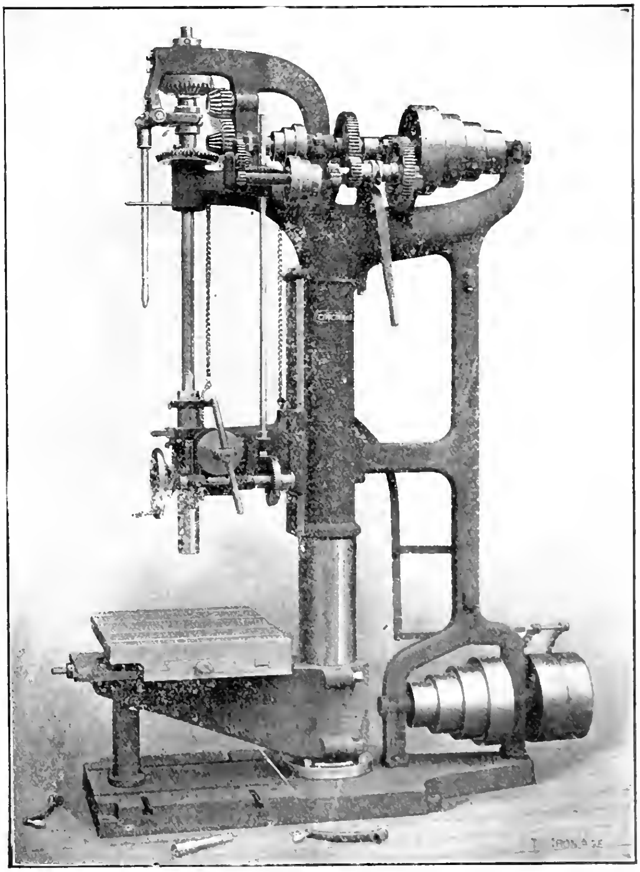
Niles-Bement-Pond Co.'s Hydraulic Boring Lathe—Back View.

The mode of operating this machine is to force 4 feet of the boring-bar into the work. By that time the clamping head is up to the work and 4 feet distant from the cylinder. The quick traverse is then brought into play and the clamping head is pulled back until it comes up to the cylinder. The inner boring-bar is then pushed 4 feet further forward and the boring-bar is once more forced into the work another 4 feet. This alternate action of forcing the bar into the work and drawing the clamping head back so as to take a new grip is repeated until the centre of the work is

reached. Before setting up new work, whereby, of course, the position of the clamping head and cylinder may have to be relocated, the following mode of operation is adopted: Supposing the cylinder and clamping head are near the centre of machine and are wanted at the extreme end of the machine; then first clamp the clamping head to the bed and by means of the quick traverse push the cylinder back 4 ft.; then clamp the cylinder to the bed, unclamp the clamping head, and run it back 4 feet. Repeat this cycle of operation as many times as necessary. The inner boring-bar can, of course, be withdrawn in one operation. The piping for the different cylinders is at the rear of the machine supported in brackets or rollers where the piping is sliding. There are handles for operating the various valves both on the front and rear sides of the machine.

CINCINNATI HEAVY PATTERN UPRIGHT DRILLS.

The latest upright drill made by the Cincinnati Machine Tool Co. is here shown, this particular machine being fitted with patent geared tapping attachment on spindle with quick return motion, and also with compound table. The tapping attachment, as illustrated, is applied to machines from 24 inches up, and the manufacturers claim that this attachment makes the drills the most efficient on the market for drilling and tapping work, such as generally done on high-priced machines. These drills fitted with this attachment are but little higher in price than a machine fitted with friction clutch pulleys, when the additional belting and line shaft pulleys are taken into consideration. By the use of this attachment drilling and tapping can be done very much quicker than on machines arranged with friction clutch pulleys, or tight and loose pulleys, as the operator has full control to stop, start and reverse the spindle instantly, thereby being enabled to do a greater amount of work owing to the reduced time in making changes of drills, chucks and sockets. By using this attachment either right or left-hand tapping is done equally well, a forward motion of the lever, shown at the left, starts the tap, and after the required depth has been reached, a movement of the lever in the opposite direction reverses the spindle and returns the tap twice as fast as it went forward. The attachment can be disengaged when no tapping is to be done, thus saving all the parts from wear, leaving the machine a Standard Drill, with the advantage of being able to stop the spindle instantly for making changes of chucks, sockets and drills without stopping the machine at the shifter. The success of this attachment has been so satisfactory that over 50 per cent. of all drills made by the company now embody this. The compound table shown in connection with this drill is very heavy and neat in design, so rigid that it is practically impossible to spring it. For jig and tool-room work it is most desirable, as work can be clamped on the table and brought in proper position to be drilled by use of the cross and lateral feeds. By fitting a milling arbor in the drill spindle this style of table allows milling and key seating to be done on work that cannot be done to advantage on a milling machine. The table can be swung round a column, leaving the base plate free for larger work if necessary. These tables are of very ample dimensions, and are furnished on any machines, from 24 inches up. The 21-inch Cincinnati heavy pattern drills are furnished in stationary head [illegible] and lever, with back gear, [illegible] complete with back gear [illegible] any of these machines [illegible] geared tapping attachment [illegible] tables, as [illegible] desired. The Cincinnati [illegible] furnished in the following [illegible] and 42-inch, and can all be furnished with the patent geared tapping attachment, compound tables [illegible] as desired. Any of the machines can [illegible] motor drive, either direct geared or belt [illegible] mailed on addressing the [illegible] Spring Grove Avenue and Township [illegible] Cincinnati, Ohio.



Cincinnati Machine Tool Co.'s Upright Drill.

VACUUM PRACTICE AS APPLIED TO LOW TEMPERATURE EVAPORATION.*

By H. G. Spurrier, Toronto Junction.

In all steam power plants of any magnitude, the vacuum pump is one of the necessities of economical power production, and in this connection its operation is well understood. But of late years much of great chemical and mechanical import has been developed. Modern industries and developments have demanded the production of materials that were, a few years ago, scarcely more than curiosities. Research has shown that many bodies can be produced of better quality and more cheaply by aid of the low temperature boiling points secured in vacuum apparatus than by any other method. And, as is always the case, the manufacturer has followed close in the wake of the scientist, and

* A paper read before the Canadian Association of Stationary Engineers.

has converted the science of the laboratory into the art of the factory.

I will confine my remarks to one particular line in which I have, for some time past, been accumulating experience of more or less value. The enormous increase of mining and other operations has resulted in a much increased demand for dynamite, which, in its turn, has much increased the demand for glycerine, which, as you know, is the all important constituent of nitro-glycerine. Glycerine is produced from the animal and vegetable fats and oils which contain from 5 to 11 per cent. This is the source of all the glycerine produced, and it comes by way of the soap industry almost entirely.

It may not be uninteresting to know that fats and oils are definite chemical compounds of fatty acids with glycerine, and in the manufacture of soap the soda used seizes the fat acids forming a soda compound with them, and, at the same time, expelling the glycerine, which is subsequently found in the spent lye. Only a few years ago these spent lyes—which were a long way from being spent—were discharged into the sewers, carrying with them a valuable freight of soda, salt, and glycerine. This is now all changed and no modern soap factory is without its chemist and glycerine plant. After the lyes have been purified and filtered through presses, they are evaporated in an apparatus of considerable size, as large volumes must be handled, the one essential of successful operation being a high vacuum of great steadiness.

At this point we reach the crucial difference between vacuum pan-practice and condensing engine practice. The engine uses and passes on to the condenser a definite volume of steam varying only as the load on the engine, and in direct relation thereto. Should the vacuity increase, the steam can come no faster than it is permitted by the opening of the exhaust valves. But, on the other hand, the higher the vacuum the less will be the steam consumption, because the mean effective will be increased by the increase of the vacuum. So vacuity in engine practice is important only as an economizer, but it is otherwise in the glycerine plant. Here it is as though the condenser is hitched up to a low pressure boiler, for we have a large steam drum continually pouring heat into the liquor in the machine and the vacuum must be kept uniformly high to avoid loss. To emphasize this point, let us suppose that we have 10,000 lbs. liquor in our evaporator, and we are running on a low vacuum of, say, 24" corresponding to a boiling point of 141 deg. F., and for some reason, such as cooler injection or perhaps a lower steam pressure in the steam drums our vacuum rises to 28" corresponding to a boiling point of 109 deg. F. We have a difference of 109 to 141, equal to 32 deg. F. in the boiling point. Now, 1 deg. F. per lb. is equal to 1 B.T.U., but we have a difference of 32 deg. F. in each pound, which amounts to $32 \times 10{,}000 = 320{,}000$ B.T.U. suddenly set free. But a compensating occurrence mends matters somewhat, viz., that at 28" vacuum the latent heat of vaporization is 1043 units, as against 1015 units at 24" a difference of 28 B.T.U. This multiplied by our 10,000 lbs. would use up 280,000 of our 320,000 thermal units, leaving a balance of 40,000 units of superheat which is suddenly used up in vaporizing the liquor.

Now 40,000 thermal units will vaporize 40 lbs. of liquid boiling at 28", each pound of which vapor will occupy 334 cubic feet at 28" vacuum, and $334 \times 40 = 13{,}360$ cubic feet. Of course, this sudden generation of vapor so lowers the degree of vacuity, in consequence of which the B.P. rises; but the vacuum again tending to rise brings down the boiling point again with the consequent evolution of large volumes of vapor. The consequence is that large fluctuation and loss ensues. These remarks apply precisely to steam generation in boilers; for suppose we have a boiler at 100 lbs. gauge pressure you have nominally 115 lbs absolute pressure, whereas at 28" so-called vacuum you have about 1 lb. absolute pressure. The sudden generation of vapor, consequent upon the sudden rise in vacuity, is the exact counterpart at different pressure of that class of priming in boilers brought about by a suddenly increased demand for steam; for vacuum is only another name for pressure so low that it is less than that which the atmosphere imposes upon us. If steam rises faster than 2 to 3 ft. per second from water, it will carry spray. It would result in making matters much more easy and less ambiguous for engineers were all pressure gauges to read from absolute pressure. We have in the Fahrenheit thermometer a similar misnomer in the zero and below zero degrees, which arose from the ignorance prevailing at the time this thermometer was constructed. We know to-day, and frequently record the fact, that Fahrenheit's zero is not zero—or point of no heat—when we register degrees below zero; and we have in physics also an absolute zero, or, as we would say, 488 deg. F. below zero.

In order to become warned in time of the disastrous fluctuations of vacuity, the author has devised a special gauge and alarm (described elsewhere in this issue), which has resulted in the saving of much valuable material.

In practice our spring gauges show how many inches of vacuum we realize, but they give us no idea of what per cent. of vacuity is reached. For instance, 26" vacuum on the gauge would represent 92.8 per cent. of vacuity on a day when the barometer read 28", but the same gauge reading on a day when the barometer read 29.7 would be only 87.6 per cent. With the object of having an instrument which would infallibly show how far short of perfect vacuity we come, another little device was arranged which has also been of inestimable advantage. A glass tube of about 3-16-in. internal diameter was sealed at one end and bent into the form of a close U, the open end being longer than the closed end. This tube was nearly filled, very hot (to avoid the presence of any moisture), with mercury. When erected, the mercury filled the closed leg, the bend, and about 1-in. of the open leg. On connecting this tube with the exhausted apparatus, the mercury will descend in the closed leg and will, of course, rise correspondingly in the open leg, till the level of the mercury in the two legs differs by an amount exactly equal to the difference between the vacuum realized and absolute vacuity (neglecting, of course, the loss due to the vapor tension of mercury which at ordinary temperatures is infinitesimal).

Some few points in regard to pumps and joints may be of practical interest, as coming from practical experiences. In an evaporating glycerine plant there are necessarily many large joints and an almost bewildering number of valves from ¼-in. to 10-in. diameter. On our joints we invariably lavish a generous supply of "asphalt paint," which will stand exhaust steam heat and is immune to the action of acids and alkali, and will allow when warm of the thickened masses being sucked into leaks successfully stopping them if not too large, but, very large leaks may be stopped by adding dry red lead to the paint.

In regard to pump valves, the lighter the better, commensurate with sufficient strength, and in regard to springs I have discarded them entirely on the suction at times and have benefited thereby. In operating stills where the dry vaccum pumps are used only enough water passes to seal the valves, and it is well that they be slung on the underneath of the suction valve plate, the springs being only just strong enough to raise them to their seat. The great importance of a high vacuum on glycerine stills has led to the connecting of a second pump to the discharge of the first. It is manifest that on the dry vacuum pump there must always be sufficient atmosphere of some sort to move the valves from their seats, hence the importance of light valves and carefully adjusted springs—nevertheless on this class of work we have regularly run up to within ⅝-in. of perfect vacuum. Surface condensers are used on this class of work, the condensed material being valuable. In the plant where I am now engaged our pump on the evaporators discharges against a vertical head of 22 feet, and a horizontal run of about 73 ft.; but as this pump handles large volumes of water, we still find it possible to average 28½-in. vacuum. The discharge passes down through a cooling tower, thereby enabling us to operate on about 3,000 gallons.

The Canadian Engineer

Vol. XI.—No. 6. TORONTO AND MONTREAL, JUNE, 1904 PRICE 10 CENTS $1.00 PER YEAR

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY, MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada, Great Britain and the United States, $1.00 per year, foreign, 6s. Advertising rates on application.

OFFICES—18 Court St. Toronto; and Fraser Building, Montreal.
Toronto Telephone, Main 4310. Montreal Telephone, Main 2589.
BIGGAR-SAMUEL, LIMITED, Publishers,

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 15th of the preceding month or if proof is desired, 4 days earlier.

CONTENTS OF THIS NUMBER:

MORE LESSONS FROM RECENT FIRES.

On referring to the account of the Baltimore fire of February last, one cannot fail to be struck with the marked similarity of many of the features of the Toronto fire of April 19th. This we referred to in the last issue of the Engineer; but there are some points which are worth further consideration.

These two fires have shown how irresistible a modern city conflagration may become when it has once gained headway. The efforts of the best organized fire brigade, with their devices, become puny in comparison with the force against which they offer protection. They also show the exceeding combustibility of the average modern city. In Baltimore there were a number of steel skeleton, supposedly fireproof structures, which succumbed, but these were not totally destroyed, and may be restored without excessive cost, the walls in most cases standing intact, and the destruction being confined to the interior. Where stone was used for facing, or for columns, or decorative work, it was sadly injured by spalling, and stone showed itself equally liable to injury in the Toronto fire. Where steel skeleton construction is employed brick seems to be the only effective facing. In the Baltimore fire there were six large buildings of this form of construction, and in all of them the steel framework is intact, and with a new member in one or two places will be as good as ever. In all of them the walls are structurally sound, and most of the floor arches are intact. In all, however, every window and every item of finish and contents was destroyed. In all, ignition resulted from the flames of adjoining non-fireproof buildings breaking through the windows. In one of the buildings there were shutters of wood covered with steel, but the building ignited from the other side, and with fire on both sides the shutters burst open and became badly warped. There were no steel skeleton buildings in the Toronto fire area, but the experience of the Baltimore fire seems to indicate many advantages of that form of construction. Outside the steel construction the destruction in Baltimore was complete, and as there were no such buildings in the Toronto fire the destruction everywhere was complete.

The advantage of having telegraph and telephone wires underground was shown in the Baltimore fire, where repairs were easily and quickly made. In Toronto a tangled mass was all that remained, and communication was interrupted for some time till the lines were rebuilt.

Many of the Toronto firms which were burned out are pursuing a wise course in rebuilding their manufacturing premises in more isolated positions and having only warehouses or offices in the congested district. This is not, however, altogether on account of the risk, but partly the result of an increase of insurance rates. Certainly the risk of a repetition of their losses will be greatly reduced.

Many of the sites in the burnt district of Toronto are offered for sale, and from present appearances the city is not going to rise from its ashes as rapidly as was first hoped.

SMELTING IRON BY ELECTRICITY.

In the last issue of the Canadian Engineer reference was made to the result of the visit of Dr. Haanel, and those associated with him, who were sent as a commission to enquire into the question of electric smelting of iron in Europe. Dr. Haanel's report has not yet been given to the public, but some of the results of his observations are known, and from these it may be inferred that smelting by electricity can be successfully and economically carried on. As stated already, the most important experiments witnessed were at [illegible], in the Pyrenees, where some ninety tons were put through to illustrate the process. The furnace there employed is of the resistance type, and consists of two iron casings of square cross section, forming two shafts communicating with each other at their lower end by means of a lateral canal. The cases are lined with refractory material. The base [illegible]

shaft is formed by a carbon block. These blocks are in electric communication on the exterior of the furnace by means of copper bars. The carbon electrodes to which electric current is distributed pass two-thirds of their length into the shaft. The electrodes are prisms 72 centimeters in diameter and 135 centimeters long. Three sets of experiments were made as follows: (1) Electric reduction of iron ore and obtaining different classes of pig, grey, white and mottled. (2) Electric reduction of iron ore containing a definite amount of carbon in the charge, with a view of ascertaining the amount of electric energy absorbed in the production of one ton of pig iron. (3) The manufacture of ordinary steel of good quality from the pig manufactured in the preceding experiments. The electric energy absorbed per ton of pig was found to be .226 horsepower years. The processes were quite satisfactory to the commission.

Of course the question of cost is an important factor. The following are the figures which make up the approximate cost of producing a ton of pig iron: (1) Ore (hematite) metallic iron 55 per cent., 1 842 tons at $1.50 per ton, $2.76: (2) Coke for reduction .33 tons at $7 per ton, $2.31. (3) Consumption of electrodes at $5 per 220 pounds, 77 cents. (4) Lime, 3c cents. (5) Electric energy .226 horsepower years at $10 per e.h.y., $2.26. (6) Labor at $1.50 per day, 90 cents. (7) Different materials, 20 cents. (8) General expenses, 40 cents. (9) Repairs, maintenance, etc., 20 cents. (10) Amortization (machinery and building), 50 cents. Exclusive of royalty, $10.60.

In his conclusions Dr. Haanel points out that the results obtained at Livet were the results of experiments in furnaces not specially adapted to the work required to be done. With the improved furnaces of which the commission has secured detail drawings, better figures can be obtained. He remarks that the processes of electric smelting must yet be regarded as in the experimental stage, no plant existing at present where pig iron is commercially reduced to pig by the electric process. The more remarkable therefore it appears that experiments made off-hand, in furnaces not at all designed to be used for the production of pig, should give a figure of cost which would enable an electric plant properly designed and managed to compete with blast furnaces.

As experience is gained better and cheaper methods will be introduced, and it is reasonable to suppose that as the electric process is applicable to the smelting of all other ores, such as copper, nickel, silver, etc., it can be successfully applied to the production of iron and steel. The full text of Dr. Haanel's report will be awaited with much interest.

THE ST. LAWRENCE ROUTE.

The St. Lawrence route, which acquired such a bad reputation last season, bids fair to retain its bad name, three disasters having occurred during last month, within a few days of each other. The Allan liner Hibernian went ashore near Cape Ray, Newfoundland, and is a total wreck. The Turret Bay, of the Inland Navigation Co.'s fleet, and one of the best of the coal carriers of the St. Lawrence, went ashore on St. Paul's Island, near Newfoundland, and all her crew but nine were lost. The Vancouver, of the Dominion line, went ashore near Matane, but fortunately got off without injury, after a detention of about 12 hours. All these accidents are attributed to fog. It is to be hoped that the establishment of seven wireless telegraph stations, which the Dominion Government has contracted with Marconi to have in operation by next season,—in fact four of them are promised by August next—will have the effect of preventing such disasters in future, for fortunately the electric current is not interfered with by fog. The four stations to be established at once will be at Fame Point and Heath Point, and at Point Amour and Belle Isle in the northern channel. The three other stations will be at Cape Race, Sable Island and a point near Canso.

—We have to congratulate our esteemed contemporary, the Engineering News, of New York, on having reached its thirtieth anniversary. Commenced as a modest monthly in Chicago, under the name of The Engineer and Surveyor, it soon became a weekly, and it has prospered in every way, and is now one of our most valued weekly exchanges. It was established by George H. Frost, who still remains its active head. We wish it continued success.

NEW CATALOGUES.

Copies of the following catalogues can be had by those interested on referring to the Canadian Engineer:

The Goldie, McCulloch Co., Galt. Heavy Duty Engines.

The Jenckes Machine Co., Sherbrooke, Que. Standard Crushing Rolls.

Sheldon & Sheldon, Galt, Lumber Dry Kilns, Lumber Trucks, Transfer Cars, etc.

The Shawinigan Water and Power Co., Montreal, and Shawinigan Falls, Que. Its Property and Plant.

Canadian General Electric Co., Toronto. Street Fixture, Ceiling Fan, Motors, Noark Fuse and Service Boxes, Noark Single Branch Cut-out Blocks.

H. W. Petrie, Toronto. Monthly Stock List of New and Second-hand Boilers, Engines, etc.

Works of Westinghouse Electric and Manufacturing Co., East Pittsburg, Penn. Their Industrial and Sociological Aspect, illustrated with Camera Pictures.

Fairbanks, Morse & Co., Chicago. Pumping Machinery, Jack-of-all-Trades Engine, Dynamos and Motors.

Browne & Sharpe Manufacturing Co., Providence, R.I. General Catalogue of Tools, etc.; Clamp Ring for Micrometer Calipers.

Hallidie-Painter Tramway Co., San Francisco. Wire Rope Tramways.

Joseph Dixon Crucible Co., Jersey City, N.Y. Wire Rope Lubrication.

Duluth Gas Engine Works, Duluth, Minn. Reversible Speed Propellers.

Thos. G. Grier, Chicago. Advice to Young Men—"Circular Loom" Flexible Conduit

Diamond Saw and Stamping Works, Buffalo. Saws.

Kynoch, Ltd., Birmingham, England. Roller Bearings.

Pittsburg Meter Co., East Pittsburg, Pa. Acme Dry Gas Meter.

John Steptoe Shaper Co., Cincinnati, O. High Grade Machine Tools.

Jeffrey Manufacturing Co., Columbus, O. Conveyers, etc. Coal Cutting Machinery.

DeLano-Osborne Engineering Co., Toronto. Bridges.

James Morrison Brass Manufacturing Co., Toronto. Fairbanks Bathroom Scale.

—The Ontario Association of Stationary Engineers held its annual meeting in Brantford, May 23rd, when the following officers were elected: President, J. G. Bain; vice-president, Geo. Fowler; registrar, W. G. Blackgrove; treasurer, Charles Moseley; auditors, W. J. Webb, H. E. Terry, all of Toronto. The Board of Examiners, of whom there are twelve, were re-elected. The next meeting is to be held in Toronto.

LIGHT, HEAT, POWER, ETC.

The Strathcona Electric Co., N.W.T., has been dissolved.

The Blindman River Electric Power Company has been incorporated in the North-West Territories.

Toronto is considering the advisability of appointing an electrical engineer as a permanent city official.

The Ottawa Council has decided to give the Ottawa Electric Co. a ten-year contract for lighting the streets at the rate of $52 per lamp per year.

J. M. Campbell has been granted leave by Kingston city council to erect poles and wires in the streets to bring power for his own use from Kingston Mills.

St. Catharine Road, the drive around Mount Royal, Montreal, is to be lighted with electricity. The contract has been awarded to the Montreal Light, Heat and Power Co.

The Brandon Electric Light Co.'s dam on the Assiniboine river, nine miles west of the city, was washed away by the high water, and the power house placed in great danger.

It is proposed to supply Midland, Ont., with electricity developed at Port Severn, where Mr. Ackerman proposes to develop water power capable of producing upwards of 3,000 h.p.

The power house for the Sydney Mines lighting plant will be 47 x 38 feet, and will be built of silicate brick. The poles are being shipped from Rimouski. W. A. McKay & Co. are the contractors.

Mrs. Boxer, of Montreal, has recovered $490 damages from the Montreal Water and Power Co. for injury by vibration and smoke from defendants' power houses, which caused her to lose some of her tenants.

W. D. Ross, Toronto, has been added to the board of directors of the Trinidad Electric Co. The company's rails extend over thirteen miles in the city of Port of Spain. Their last year's business shows good results.

After the fire at the Parliament Buildings, Toronto, an electrical expert was called in, and on his recommendation the wires have been re-insulated to reduce the danger of another fire from any defect in the wiring.

Lanark village is about to introduce electricity for street lighting instead of coal oil. The Shelby Co., of Montreal, has agreed to furnish twenty street lights of 50 c.p. for $312.50 a year. The coal oil system costs about $200.

A bill to incorporate the Bathurst Electric and Water Power Co., of Bathurst, N.B., is before the New Brunswick Legislature. The promoters will absorb the Sumner Company, of Bathurst, and will get power from the Tetagouche river.

Motor Age says that leaky joints in gasoline or water pipes may be made tight by means of coarse linen or canvas, covered with a paste of litharge and glycerine. This should be again covered with a bandage of adhesive or sticky tape, such as is used for electrical purposes.

The Nova Scotia and Mexican Mining Co. have had Mr. Frame, a civil engineer from Rhode Island, examine the water power of the North-west Arm Brook, between Sherbrooke and Goldenville, for the purpose of establishing an electric plant for supplying power to their works at Goldenville.

Robert A. Ross, of the engineering firm of Ross & Holgate, Montreal, has been asked to make an estimate of what is required to place the plant of the Kingston Light, Heat and Power Co., taken over by the city, in good condition, not only for ordinary service, but for supplying power to the street railway company.

The Montreal Light, Heat and Power Co. has abolished the office of engineer and superintendent, formerly occupied by P. G. Gossler. W. McLea Walbank, as chief engineer, will have charge of the engineering department, and the staff will be strengthened by the appointment of an electric expert.

R. B. Hamilton, managing director of the Packard Electric Company, of St. Catharines, reports business as particularly brisk, and that the entire plant has just been under the remodelling process to provide enlargements for their lamp, transformer and meter departments. Additional equipment is being placed in all departments. One order recently received by the company was for 1,500 type "G" recording watt meters. This order is believed by the company [illegible] the largest single order ever received by any Canadian [illegible] tric company. All of the 1,500 meters must be delivered before November 1st of this year.

The Continental Light and Heat Company [illegible] an offer to light the streets of [illegible] annual charge of $18 per lamp [illegible] dition that the contract shall extend [illegible] less than ten years.

A deputation composed of W. Y. S[illegible]er and A. A. D[illegible] of the Ottawa Electric Company; J. J. Wright, of the Toronto Electric Light Company; E. A. Evans, of the Quebec Light and Power Company; A. A. Wright, M.P., of the Renfrew Electric Light Company, and C. W. Henderson, of the Canadian Westinghouse Company, Hamilton, recently waited on the Government to press for the enactment of legislation to protect them against the theft of electric current. Many cases have been brought to their notice where power and light was stolen, and such ingenuity employed to cover up the fraud that it was impossible to bring the crime home to the offenders. As a rule, the manipulation of wires, etc., is carried on within the consumer's premises. The electric companies seek an amendment to the law which will make the discovery of any device to deter a meter or to divert current prima facie evidence against the individual in whose behalf it is used. The Government is also asked to establish an electrical standardizing bureau to provide absolute standards for the measurement of electrical quantities.

If the Fort Frances Times is correct the Federal Government should lose no time in nipping the development of the Minnesota Canal and Power Company in the bud. It is claimed that they are at work upon a project which threatens serious damage to Canada's power interests. The facts are briefly as follows: Birch Lake in St. Louis and Lake counties, Minnesota, has a drainage area of 1,103 square miles. The annual run off through the lake is 26,000,000,000 cubic feet of water, which finds its way to Rainy Lake and River. The water shed of Rainy Lake is about 16,000 square miles, of which the Birch Lake water shed is about 7 per cent. The Embarrass River, which flows into the St. Louis, and thence to Lake Superior, rises in a swamp within a few miles of Birch Lake. The company proposes by means of a system of dams, reservoir and canals to gather all the waters of the Birch Lake basin and carry them into the Embarrass River and Lake Superior. If this is done the flow of Rainy River will be lessened by about 7 per cent. Every water power between Rainy Lake and Lake Winnipeg will suffer and navigation will be seriously affected.

* * *

Brantford's special committee will unanimously recommend a municipal telephone system.

The new turbine steamer to run between Hamilton and Toronto is expected to reach Hamilton bay about the middle of this month.

There is a strike on at the Dominion Iron and Steel Co.'s works, at Sydney, C.B., and operations are almost entirely suspended in consequence.

The 27th annual convention of the National Light Association of the United States was held at Boston, May 24th, 25th, 26th and 27th. The total attendance reached over 1,000, among whom were a number of Canadians.

The Chicora, of the Niagara Navigation Co., is running well this season, having been thoroughly overhauled. New plates and two new cylinders have been put in and the captain's quarters have been moved to the hurricane deck, leaving more shelter for the passengers on the forward deck.

Eight tenders were received for blasting the tunnel for the Orillia power development repairs at Ragged Rapids. If the method proposed is found too expensive, an alternative plan is proposed, namely, to blast out a channel for the river across the narrow but high neck of rock on the west side and divert the river while the concrete dam is repaired. Temporary power to a limited extent could by this means be secured while the work is in progress.

CANADIAN WESTINGHOUSE WORKS.

The advancement of Canada as a commercial nation has been remarkable during the past few years. The new impetus has been felt in development of water powers, in mining, agriculture, transportation and manufacture, and the increment of each has reacted to swell the contribution of others until at present Canada finds herself on a rising tide of prosperity, all the more marked in comparison with the hesitancy and stagnation apparent in many other portions of the business world. Among the various fields of activity, that of manufacturing has more than held its own. Not only have resident Canadians been alive to the opportunities of the period, but also individuals and corporations of other countries have been led to establish manufactories within the country, to aid in supplying the growing consumption of their products.

A highly interesting installation of the latter sort is the new plant under construction at Hamilton, Ontario, for the manufacture of the well-known types of the Westinghouse Electric & Manufacturing Company. From the time when electrical apparatus was first made use of in Canada, the Westinghouse Electric & Manufacturing Company, of Pittsburg, has furnished a large and increasing portion of this apparatus in the Dominion, until now the time has arrived when in justice to their customers it is found advisable to establish a distinctively Canadian factory, to secure that intimacy of relation which is so advantageous alike to the manufacturer and client. Passing in review the various sites suitable for the location of such a factory, it was natural that the choice should fall on Hamilton, not alone from the natural advantages of that city from the standpoint of a manufacturer, but as well from the fact that for a term of eight years another Westinghouse interest, the Westinghouse Manufacturing Company, Limited, had been located in that centre, engaged with marked success in the manufacture of the Westinghouse Air Brakes for the equipment of Canadian rolling stock.

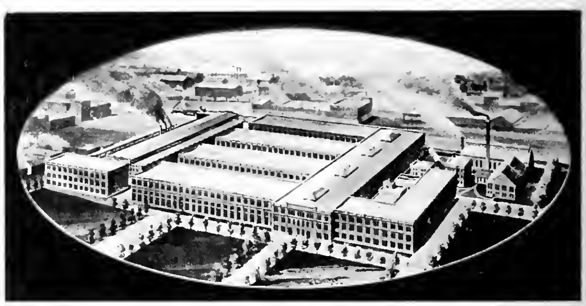
To join under one management the existing air brake business and the electric business to be instituted, a new organization was formed under the name of the Canadian Westinghouse Company, Limited, and, leaving the air brake factory in its present state of efficient equipment, work was at once started to provide a plant of modern excellence and completeness for the manufacture of electrical apparatus. Notwithstanding an unusually severe winter, construction work has been pressed throughout, until at present writing it is safe to say that an operative condition of the plant will be reached this fall. The Canadian company will operate under the enjoyment of an agreement with the Pittsburg companies, by which all designs and processes of the older companies will be at its disposal, and thus fortified with the results of years of successful experience, equipped with a plant than which no better can be found, and aided by the co-operation of many of Canada's most representative citizens, an assured future stands before the company, and the Canadian user is assured of the best obtainable apparatus. The lines of manufacture to be taken up comprise alternating and direct current generators; alternating and direct current motors, including railway motors; controllers, transformers; switchboards and switches; rheostats; instruments; meters; arc lamps, and various subsidiary apparatus included in the general line of Westinghouse equipment.

The new buildings provided consist of foundry, pattern shop, pattern storage, general machine shop, detail machine shop, warehouse, insulation treating building, boiler house and transformer building. On the diagram of the property shown in the illustration, these are lettered from "A" to "I" inclusive, in the order just recited, "L" is the brake plant, and "K" the office building, enlarged to accommodate the increased force of the new company.

In laying out the manufacturing buildings on the property two cardinal points were kept in view—the first, that progress of material from raw to completed state should, as far as possible, be in a continuous direction; and the second, that the plan adopted should lend itself to an initial installation which would constitute a complete unit, and also be capable of reproduction along its own lines to an extent limited only by the total available property. On the latter point it may be said that something less than half of the total installation shown in the illustration is at present under construction, the northern half of the foundry and warehouse, along with corresponding machine shop wings being left for future extensions. Regarding progress of material through the plant, it may be pointed out that with raw material received on track west of the foundry, progress is in general from this point to the warehouse, from which all shipments are to be made over tracks conveniently located within the building for this purpose.

The foundry is of monitor roof construction, with middle and two side bays. In the west bay are located the cupola house, the core room, and the brass floor, while just inside, along the west wall are located the bins for pig, sand, limestone, etc. A portion of the east bay is separated by partition from the foundry space to serve as blacksmith shop. The main bay is served by a 20-ton crane, the length of the building being also traversed by travelling jib cranes, operating at a lower level. A mezzanine floor over a portion of the core room provides suitable toilet facilities without reducing productive floor space. An electrically driven elevator is provided to deliver iron from yard to charging floor, and a coke conveyor, also electrically driven, receives coke from railroad car and deposits it in an appropriate bin on the charging floor.

The pattern shop, located conveniently near the foundry, is three stories in height, besides a basement to accommodate shafting for machinery on first floor. The first floor is devoted to carpenter and cabinet shop uses, while the second and third floors are for pattern making. An electric elevator serves this building from basement to top floor. The pattern storage building adjoining is similar in construction, except the basement, which is unnecessary.



Bird's eye view, Canadian Westinghouse Co.'s new works, Hamilton. The small cluster of buildings around the smokestack represent the present plant of the Westinghouse Air Brake Co.

The general machine shop is arranged with a high bay covered by 20-ton crane, and low bay with 5-ton crane. In the former the heavier machine tools are located, and it is here that mainly the stationary parts of generators and motors will be finished, while the low bay will be devoted to preparation of rotary parts, and the gallery floor above the latter will provide space for the manufacture of commutators, brush-holders, bearings, etc., also for tool room and controller department. Toilet rooms and heating and ventilating fans are placed on a narrow mezzanine floor between high and low bays, the same being reached by stairways from both the ground and gallery floors. The elevators also pass up through this floor and industrial tracks run under the mezzanine, along by the foot of the elevators on the ground floor. After the completed rotary part has received its winding at the eastern end of the low bay it is passed by

jib crane under the mezzanine floor at this point on to the eastern end of the high bay, where it is placed in its corresponding stationary part, which has been under construction in this aisle, and the auxiliary parts are received at the same point by the elevator from gallery floor. In addition to the crane serving the main portion of the high bay, this eastern end or assembling floor is provided with an additional crane of like span, but at a lower level, so that by it machines can be delivered from the assembling floor, through under west gallery of warehouse into middle bay of the latter building, where the north and south crane can pick up the load for further handling.

The warehouse has a high bay in the middle, with one gallery on the west side and two galleries on the east side. The machines delivered, as just described, from the general machine shop, are passed from the testing floor on the west side of the main bay, and after tests are finished, painted and shipped on cars from the warehouse track. This track also is the means for entry into the plant of the less bulky material and supplies, which are stored in this building for ready distribution to both the general and detail machine shops. The floor east of the tracks is at car floor level to facilitate handling of such material, and elevators are, of course, provided for distributing to the various floors.

The detail machine shop has two floors throughout, beside the ground floor at levels, corresponding to the two galleries on the east side of the warehouse, with which they directly communicate. It should also be noticed that the top floor of this building is at the same height as the gallery in the general machine shop and the west side of warehouse, and that a connection gallery at the same height is carried around the south end of the warehouse building. On the ground floor of the detail shop the coil winding and insulating departments are located, this being convenient both for receipt of wire from warehouse and delivery of completed coils to winding and assembling spaces at east end of general machine shop already referred to. The second floor is devoted to the machine work necessary on switches, rheostats, meters, instruments, arc lamps, etc., and on the third floor are the assembling and testing rooms for these lines of apparatus. No cranes are needed in this building but elevators are provided, securing easy access to various floors.

The insulating-testing building is separate from the main group so that this work, involving the use of inflammable materials, can be isolated. Convenient communication with the detail building is provided by a two-story enclosed bridge cut off at each end by fire doors.

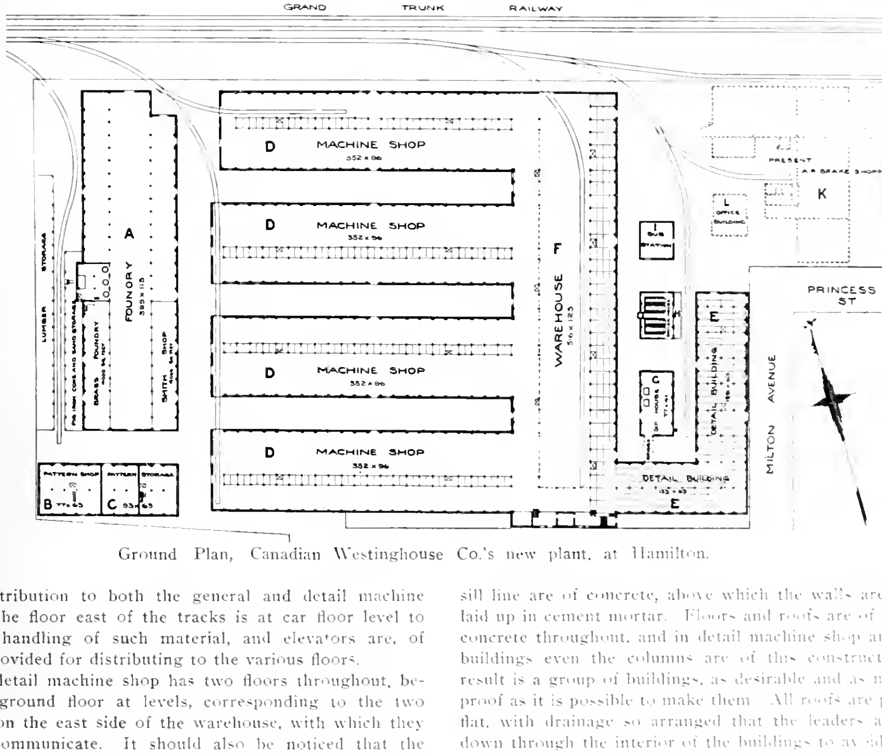
The boiler [illegible] it [illegible] be [illegible] parison with the [illegible] the use of steam will be largely restricted to [illegible] drying purposes. Most of the steam for drying [illegible] in insulation-treating building next adjoining, [illegible] ing the buildings it will be piped to [illegible] installed in each building, with fans to distribute the air heated by these coils.

Power for manufacturing and testing purposes, as well as for lighting, is to be obtained from the [illegible] Power Company, which draws its supply from DeCew Falls. Current will be received in the transformer house at 2,[illegible] volts, and distributed at 440 volts for general shop purposes, although lighting distribution will be at 110 volts, and transformation to direct current will be made to supply some of the cranes and machine tools.

The construction of the buildings, which is in the hands of Westinghouse, Church, Kerr & Co., of New York, as engineers and general contractors, is of the most modern approved type. The foundations and walls up to window sill line are of concrete, above which the walls are of brick, laid up in cement mortar. Floors and roofs are of reinforced concrete throughout, and in detail machine shop and pattern buildings even the columns are of this construction. The result is a group of buildings, as desirable and as nearly fireproof as it is possible to make them. All roofs are practically flat, with drainage so arranged that the leaders are carried down through the interior of the buildings to avoid stoppage by freezing in cold weather. Floors are top dressed with 1-inch maple, and roofs with tar and gravel.

Transportation between the foundry and all buildings, including the air brake plant, will be by industrial railway, operated by storage battery locomotive. The standard gauge tracks on the property are directly connected with the main line of the Grand Trunk Railway for receipt of material and shipment of product. The main entrance to the plant, for employees, is at the south end of warehouse building, a central point at which will be located time checking devices, and from which stairways lead directly to the various floors. Entrances for teams from the city streets are provided near west end of machine shop and in front of the office building. The equipment of the plant will be on the most modern approved lines, as developed by experience of the Pittsburg factories.

The directors of the company are:—George Westinghouse, H. H. Westinghouse, George C. Smith, Frank H. Taylor, L. A. Osborne, Thos. Ahearn, W. Y. Soper, Paul J. Myler, C. F. Sise, Hon. J. M. Gibson; and the officers are



Ground Plan, Canadian Westinghouse Co.'s new plant, at Hamilton.

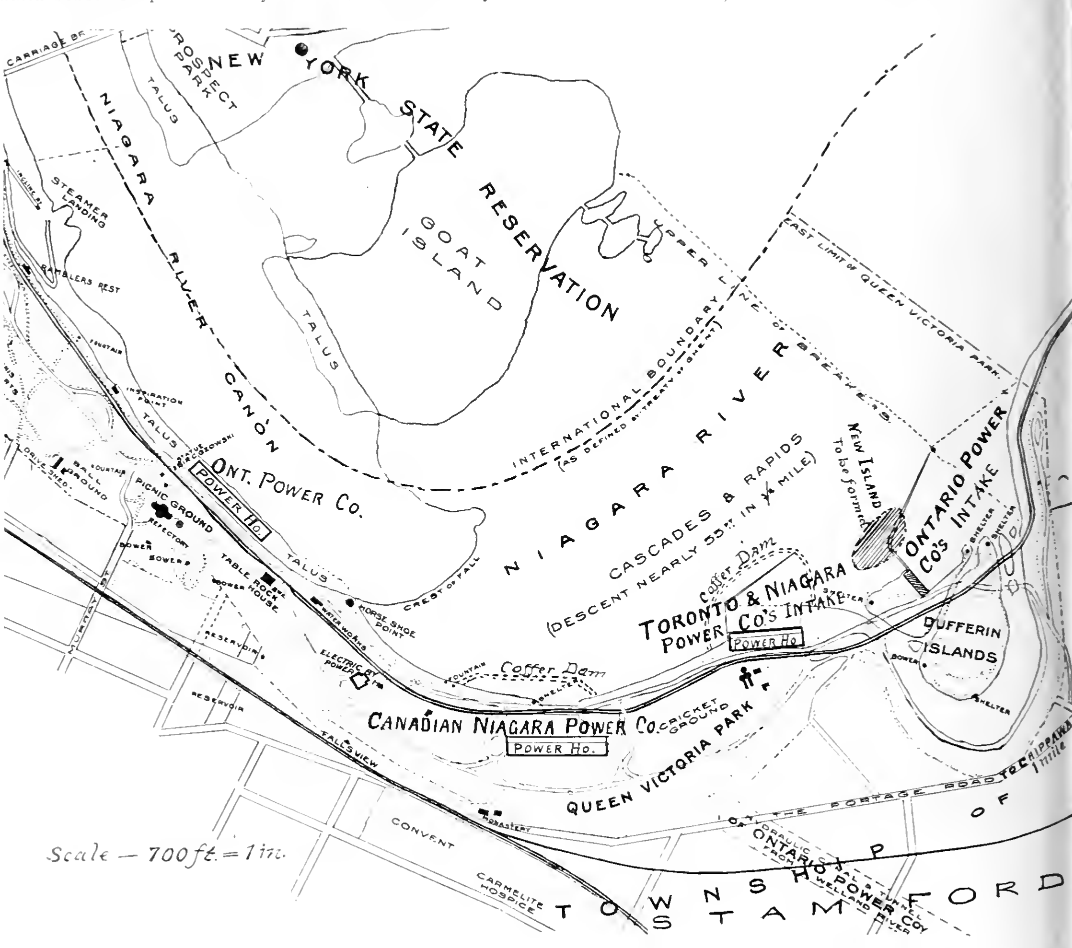
President, George Westinghouse; vice-presidents, H. H. Westinghouse and Frank H. Taylor; general manager and treasurer, Paul J. Myler; secretary, John H. Kerr; sales manager, N. S Braden; superintendent air brake department, Percy Domville; superintendent electric department, F. A. Merrick. The head office of the company is at Hamilton, and district offices have been established at Montreal, Toronto, Halifax, Vancouver and Winnipeg.

❧ ❧ ❧

ELECTRICAL DEVELOPMENTS AT NIAGARA.

In anticipation of the visit of the Canadian Electrical Association to the Falls this month it will be interesting to know the present condition of the three great power developments now being carried out on the Canadian side of the Niagara river. Our last general survey of these works appeared in July of last year, when all the developments were in progress. Notwithstanding the past severe winter, which rendered operations very difficult, work was kept going, and the scene to-day is busier than ever. The face of the beautiful landscape of Queen Victoria Park is more disfigured than ever, but this condition was to be expected, and will continue till the works are completed, when the handsome architecture of most of the structures will be an attraction rather than an eyesore to most of the visitors who flock here from all parts of the world. At present derricks grow in the place of shrubs in many portions of the park, and the forest of spars and hoisting tackle looks like a busy seaport, while the Ontario Power Co.'s long line of 18-foot conduit, stretching in one great curve from one forest of derricks to another, and as yet only half buried in the earth, looks like a colossal sea serpent that has become stranded here, mistaking the place for a harbor. Looking down the vast wheel pits or the perpendicular banks of the river below the cataract one sees hoisting engines by the dozen, and batteries of rock drills and rock-channelling machines, while from the depths, where men appear scrambling about at their work like ants, there arises a babel sound of clanging cogs, of screeching wire ropes, the vicious hammering of drills, the impetuous puffing of engines mingled with the more melodious tones of men in command, and with the soft and soothing sound of rivulets springing out of crevices in the rocky walls. There are now between 1,500 and 2,000 men employed directly on the three works, which are being pushed with all the speed possible.

Beginning up stream, in the order in which the power houses are situated, we find that the Ontario Power Co., which has been in construction for about two years, will probably have its generating station finished before next winter sets in. The intake and gate mechanism are situated above Dufferin Island, and the rock excavation for this



work, which has an ultimate capacity for 200,000 h.p., is now nearly finished. The retaining walls, which are to bound the forebay, are already nearly completed; and the house screen and gate mechanism will shortly be commenced, and will probably be completed before summer is over. As explained in our previous sketches, the water, after being carried under Dufferin Island Creek, will pass along a steel conduit or feeder pipe eighteen feet in diameter, and laid as near the surface of the ground as possible, till it reaches a point past the crest of the Canadian Falls, at the foot of which, on a floor of rock now being excavated for the purpose, the power house will be built. The position of

Toronto and Niagara Co.'s Power House. Designed by E. J. Lennox, architect, Toronto.

the generating station at the foot of the fall reverses the order of conveying power adopted by the other concerns on either side of the Niagara. The rapid formation of ice from the ceaseless volumes of spray at the foot of the falls renders it necessary that the work should be completed before ice forms; hence operations are being pushed with the utmost despatch. The 18-foot steel pipe referred to is 6,600 feet long, and half of this is now laid in its trench through the park. This pipe has a carrying capacity for

Toronto and Niagara Power Co.—Site of wheel pit in March, 1904.

60,000 h.p., and when this power is taken up and more required, another pipe of larger capacity but different form, the mouth for which is already installed, will be laid. The Messrs. Nunn are the contracting engineers, with Mr. Sohr, of Montana, as hydraulic expert, and J. R. Harsch in charge of the business department. Chas. H. Mitchell, of Niagara Falls, Ont., is resident hydraulic engineer.

The Toronto and Niagara Power Co. (the Electrical Development Co. of Ontario), the next in order, are pushing their works with the energy characteristic of the men at the head of its affairs, of whom Frederic Nicholls, of Toronto, is, perhaps, best known to electrical men. The concession held by this company is being executed by a company composed chiefly of the same shareholders, and known as the Electrical Development Co. of Ontario, which is now excavating the big wheel pit, over which the power house will stand, at a spot known as Tempest Point. The accompanying engravings show the rate at which the wheel pit is being sunk, the first photo. taken in March last, showing only the loose rock cleared away, while the second, taken early in May, shows a depth of nearly 70 feet excavated. The wheel pit is 416 ft. by 22 ft. and will be 144 ft. deep. At present it is sunk 90 feet in one part and 72 feet in the shallowest portion. There are 20 rock drills at work. The coffer dam surrounding the works is now practically complete, and pumping will begin a few days after this sketch is published. About 1,000 feet of the tunnel is finished, through which the water, after expending its power, will be discharged, right under the Horseshoe Falls, and at the lower or discharge end of this tunnel there remained, when the writer visited the works, only a thin shell of rock separating the workmen from the furious backwash of water and spray which drives against the wall. Sixty men are working in the tunnel day and night. The company is empowered to take 125,000 h.p. from the river, and the power house, whose classic outlines are shown in the accompanying engraving, has provision for eleven turbines of somewhat more than 10,000 h.p. each. These are being constructed by the General Electric Co., of Schenectady, and the Canadian General Electric Co., of Peterboro'. The contract calls for the completion of the whole works by June, 1905. The Toronto and Niagara Power Co. under its charter will have the right to expropriate lands, and has already completed surveys for both its transmission line and an electric railway to Toronto. This portion of the work is under the direction of W. T. Jennings, C.E., of Toronto. The right of way will have a minimum width of 80 feet. It is decided that the line will be erected on steel towers of a new type, which will lessen the risks of accident or leakage of current. B. R. Value, C.E., for seven years on the new Croton dam of New York, is resident engineer, and Robt. C. Brown, E.E., is chief electrical engineer of the transmission line.

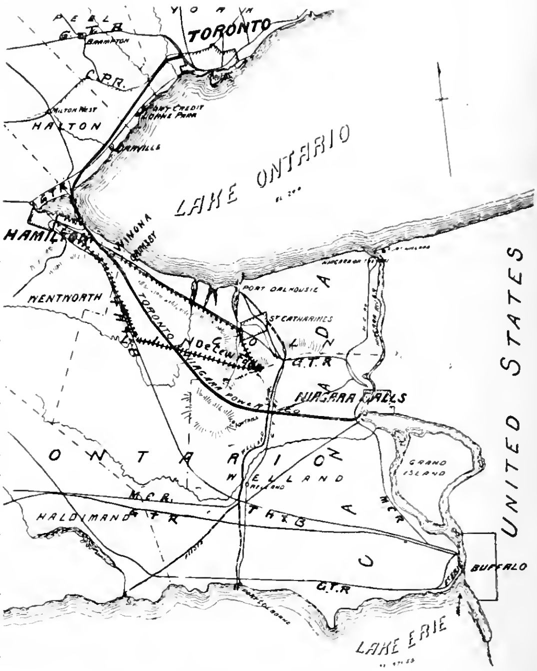
The works of the Canadian Niagara Power Co. have already been described in the Canadian Engineer, this company having been the pioneer in the development on the

Toronto and Niagara Power Co. From a photo taken May, 1904, showing progress of excavation work in wheel pit.

Canadian as its sister corporation was on the United States side of the river. The power house has a capacity of 110,000 h.p., and the whole of this immense power will be provided for at once, except 10,000 h.p., which will be held as a spare unit. The work progresses smoothly and rapidly under the skillful direction of Cecil B. Smith, C.E., the resident engineer. The wheel pit is now excavated, and a considerable part of it is lined. It is 165 feet deep, 18 feet wide inside of the brick lining, and is 570 feet long. The power house, the steel frame of which is erected by the Hamilton Bridge Works Co., is similar in design to the power house No. 2 of the company on the United States side. It is of Queenston limestone, with colored tile roofing, and will be lined with mottled buff brick, the base being of enamelled brick. Two 50-ton cranes were designed and erected for handling the heavy material for this structure, and these are operated by current taken from a transformer station on the hill above the park. This station is supplied by current taken from the power house on the United States side, from which not only these, but the other works in progress take current to the extent of about 4,000 h.p. The hoists and rock drills are chiefly operated by steam and compressed air. Of the eleven mouths for as many turbines, nine will be placed in position now, and six of these are having wheel pits cut and bricked up ready to attach the machinery, which will be ready for delivering power about December next. The turbines, each of a capacity of 12,500 horse-power, were designed by Escher, Wyss & Company, of Zurich, Switzerland, and are of the twin Francis vertical type, inward discharge, two draft tubes to each unit, discharging into the open tailrace below. Three of these units are being manufactured and installed by this firm, and two units on the same design by I. P. Morris Co., Philadelphia. The generators, each of 10,000 horse-power, are of the internal revolving field type, and will generate alternating 3-phase current, 25-cycles, at 12,000 volts. Five of these are being installed by the General Electric Company. The generator and turbine are direct connected by a vertical shaft, and will revolve at 250 R.P.M. The auxiliary machinery, consisting of exciter turbines, exciters, water pumps, oil pumps and oil tanks, etc., are located in three chambers built into the side of the wheel-pit 100 feet beneath the surface. This machinery will all be operated by an independent water service drawn from the canal above. From the portions of machinery now on the ground and in

Toronto and Niagara Power Co.—View in tunnel.

the power house one can form a fair idea of their immense power. The first dynamo is being put together, after having been erected and tested at the works in Schenectady, and then taken apart for transportation to Canada. There are 50,000 laminations in this machine, the largest in existence at the present day, its actual net capacity being 10,250 h.p., and its diameter 18 feet. The turbine to which it will be connected will exert 12,500 h.p., the weight of all the revolving parts being 187,000 lbs. The shaft on which this immense machine revolves is forty inches in diameter, of steel, and hollow except for the bearing part, which is fourteen inches in diameter, and of solid nickel steel. The steel castings forming the lower elbow of the penstock are in two sections, each half weighing 75 tons. There appears to be only one place in the world—Pilsen, Germany—where steel castings of such a size and shape can be made. The transformer station, equipped with water-cooled transformers, has a present capacity of 25,000 horse-power. It will be supplied with water for cooling purposes from pumps located in the chambers of the wheel-pit. There will also be a standpipe 116 feet high and 30 feet in diameter carrying



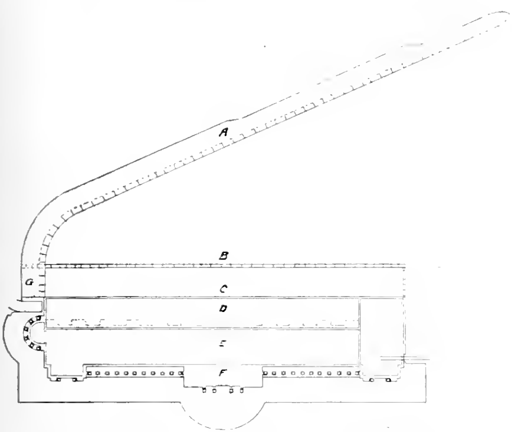
Map of Niagara Peninsula, showing transmission lines of Toronto and Niagara Power Co., and of Hamilton Cataract Power, Light and Traction Co. (the latter starting from De Cew Falls.)

one day's supply of water, to be drawn upon in case of any accident to this pumping system. This would supply 50,000 h.p. for the day. This station is now about completed. The tunnel tailrace, just completed, is 2,200 feet long and of a horseshoe form, 25 feet high and 19 feet wide, lined with 17 ins. of concrete, with vitrified brick facing. The grade of this tunnel is seven feet per thousand, which will give a speed of water when plant is in full operation of about 27 feet per second. The head canal has a clear waterway 15 feet deep and 250 feet wide, and is crossed by a five-span stone arch bridge, now finished, which carries the tracks of the Niagara Falls Park and River Railway, a carriage way and sidewalk. This canal widens into a forebay 600 feet wide, extending the whole length of the power house. The underground conduits are now being laid. The main one runs from the power house down to the Upper Arch Bridge, on which it will be carried across to the United States side for transmitting such current as is required in New York State. This conduit, which is half finished, and is 1½ miles long, will have 32 holes, with a transmission capacity of 75,000 h.p. The other series of conduits is carried to the transformer station on the hill, half a mile distant, and will contain 24 ducts, with a capacity of 50,000 h.p.

The River Ice Problem.

The plan adopted by the Canadian Niagara Power Co. for keeping the power-house clear of ice has already been described in this paper. The retaining wall forming the forebay is two feet lower at its point of junction with the walls than at the upper end. As the heavy floating ice is carried down the forebay, the narrowing of the water area and the

difference in the level of the wall tend to increase the surface current so that the thick ice will be thrown over into the river again. In front of the power-house, and parallel to its face is an outer ice rack formed of steel rods placed 10 inches apart, not standing vertically, but inclined in the direction of the current so that any ice reaching the rack may be lifted and helped down to the outlet. Coarsely screened by these rods the water passes through submerged archways under a portion of the power-house, and any small ice remaining will be caught, before reaching the mouths of the penstocks, by a second rack composed not of rods but of bars placed one inch apart



Toronto and Niagara Power Co.'s scheme of protection from ice. A, retaining wall; B, outer ice rack; C, inner rack; D, line of penstocks; E, wheel pit, F, offices.

The Ontario Power Co.'s intake has an outer forebay and an inner forebay. A fender for coarse ice with a screen for finer ice are expected to take care of these troubles.

The accompanying diagram shows the scheme which the Electrical Development Co. have adopted for dealing with ice at the Toronto & Niagara Power Co.'s intake. A. shows the wall or dam enclosing the forebay. This is 33 feet 9 inches wide at the base, 24 feet high, and is of concrete with granite coping, and a "bull nose" of granite, to break the ice striking the head. B and C are two rows of arches, the inner one being under the power-house. There is one ice screen over the outer arches, formed of bars placed 2 inches apart, and made in sections of 28 bars 17 feet 9 inches high. These can be lifted for cleaning or other purposes. The velocity of water under the arches is 2 feet 1 inch per second, and as in the case of the Canadian Niagara Power Co.'s works it is thought that frazil ice will not occasion serious trouble in the area covered by the building.

HAMILTON'S ELECTRICAL SUPPLY.

The following is a sketch of the proposed enlargement of the hydraulic power system of the Hamilton Cataract Power, Light and Traction Company, with a short description of the plant as a whole:

The company's old plant received its water from the feeder of the old Welland Canal into its own canal, being a waterway capable of carrying 250 cubic feet of water per second. This old canal extended from Allanburg to the brow of the Niagara escarpment in the neighborhood of DeCew Falls, well known in history as a military post in the war of 1812. It was from this post that Col. Fitzgibbon, apprized by Laura Secord who walked twenty miles through the woods to warn the British, set out with fifty men and captured 500 Americans who had been sent to seize the post. Immediately back of the forebay at the lower end of the canal, are three storage basins aggregating some thirty acres.

This old hydraulic system having been wholly outgrown, the company [illegible] follows: The supply is to be taken from the [illegible] of the Welland Canal through a weir constructed [illegible] of the canal especially for this purpose. From the weir the water will pass through a new canal capable of carrying 1,000 cubic feet of water per second a distance of three-eighths of a mile. At the lower end of this channel the water is delivered into a natural valley, being the bed of what is known as the Beaver Dams Creek. This stream had been converted into a lake of about 400 acres in extent by the construction of an earthen dam at its lower end. This newly formed lake will be connected with the old lake system, and some extensions of it, by means of a short additional canal of about 1,000 ft. in length. The company's waterway will accordingly (all but about a mile for the five miles) consist of a large lake or storage basin, the benefit of which in preventing anchor ice and other winter troubles will be very great. This basin will also have some value as a storage, enabling the company to use its water supply to better advantage and to install a larger plant than would otherwise be possible.

Arriving at the brow of the escarpment, the water is conducted to the power house by seven steel penstocks about 850 feet long each; one of which penstocks is now operating and four under installation. The static head upon the company's turbines is 267 feet. These penstocks are connected up to ten turbines, viz.: two of 1,700 h.p. each of Stilwell-Bierce & Smith-Vaile Company's make, two of 3,300 h.p. each of Italian make by A. Ing. Riva, Monneret & Co., Milan, Italy, and the remaining six of 6,000-h.p. capacity each, manufactured by J. M. Voith, of Heidenheim, Wurtemberg, Germany. Four of these larger turbines are under installation.

The company's generators consist of two Royal Electric 1,000 k.w. three-phase inductor type machines, two General Electric 2,000 k.w. capacity revolving field machines, and six 5,000 k.w. machines, two of which have been purchased from the Westinghouse Electric and Manufacturing Co., the make of the other machines not yet being determined.

The station is arranged to be equipped with automatic electrically operated switches, two in series on each generator. The transforming equipment consists of thirteen 2,000 k.w. oil-insulated water-cooled transformers, wound with 2,400 volt primary to 22,500 or 45,000 volt secondary. The

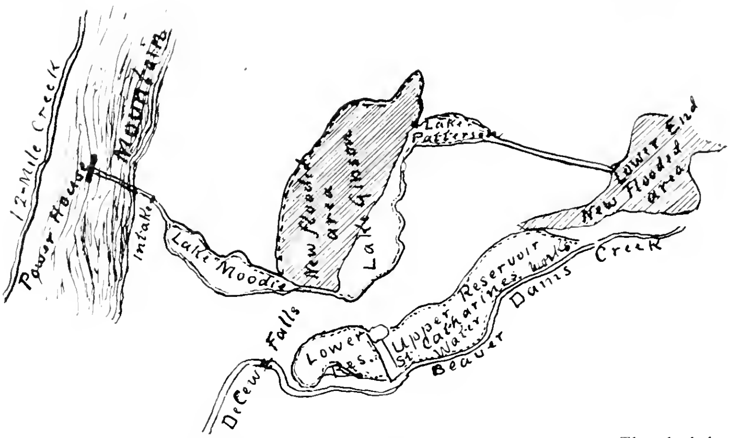
Hamilton Cataract power plant New penstocks being placed in position on the Mountain.

wiring of the transformers on the transmission lines is arranged for the higher potential

The transmission lines are two in number. No. 1 line being a 42-inch equilateral triangle composed of three stranded aluminum conductors of 380,000 circular mils area. No. 2 line consists of two triangles of No. 2 0 wire arranged in 50-inch triangles. Both lines are insulated with R. Thomas & Sons' 0-inch "Swamp" type insulator, each one having been subjected to rigid test at the manufacturer's premises before shipment. Barbed wire is used on each of the lines, and their route is shown on the map on page 158

The receiving stations in Hamilton are three in number

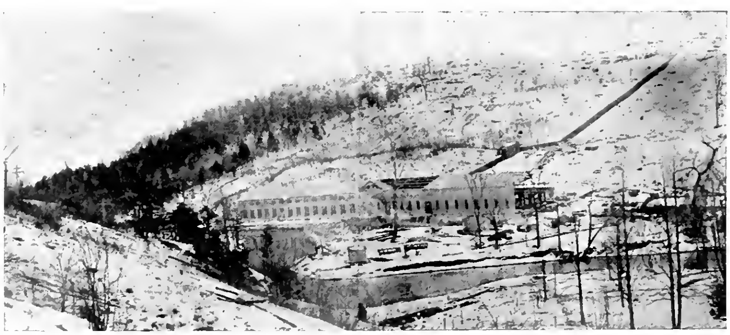
two of which belong to the company and one to one of its customers. The main sub-station on Victoria Avenue and Shaw Street contains the neces-ary 500 k.w. step down transformers, being oil-insulated natural cooled apparatus; all the incandescent lighting distributing circuits; the city arc lighting; rotaries and storage battery for the electric railways; and steam auxiliary plant of 4,000 h.p. capacity. The transforming units are 500 k.w. 20,000, or 40,000 to 2,400 volts, arranged in pairs for transforming three-phase transmission current to two-phase distribution current. The rotaries in this station are 3-300 k.w. Westinghouse 60 cycle machines run



Hamilton Cataract Power Co. Sketch showing extension of water storage area. The shaded portion shows the enlarged area of "Lake Gibson," while the beginning of a further area is indicated by the shaded patch on the right.

upon the railroad circuits in connection with a 400 ampere chloride accumulator. The street lighting equipment consists of five General Electric constant current transformers of 105 lights' capacity each. Tht steam plant consists of four 500-h.p. Stirling boilers equipped with induced draft outfit and steel stack, for 165 lbs. pressure. The engines consist of two 28 and 56 by 42 inch Goldie & McCulloch cross compound non-condensing engines, each directly connected to one 1,000-k.w. Westinghouse 2-phase alternator, which alternators feed the 2-phase secondaries busses of the step-down transformers.

The second transformer house of the company is de-



Hamilton Cataract Power House, showing new additions and penstocks leading from brow of Mountain.

signed for 12,000-k.w. of capacity in static transformers only. It is at present supplying the International Harvester Works and the Hamilton Steel and Iron Company with current.

The third sub-station belongs to the Imperial Cotton Company, containing their static transformers and switchboard, etc., etc., receiving their current at 20,000 volts and transforming it to 550 for distribution throughout their mill.

The company has three railways; the Hamilton Street Railway being the city road, and two suburban roads, the Hamilton and Dundas running from Gore St., in Hamilton, to the centre of the town of Dundas, about seven miles; the other, the Hamilton Radial Railway, extending about thirteen miles from Gore and James streets, in Hamilton, to the centre of the village of Burlington on the north shore of Lake Ontario.

In addition to lighting the city streets and furnishing power and lighting in Hamilton, the company also supplies lighting and power to the villages of Beamsville, Grimsby, Burlington, and the town of Dundas.

INTERNATIONAL RAILWAY CO.'S POWER EXTENSIONS.

Although overshadowed by the developments of the three big electrical works now in progress, the new power installations of the International Railway Co., which operates the electric railways on both banks of the Niagara, are of no mean magnitude, and are worth a more detailed notice than is given here.

There are three features of these extensions, which are being carried out by W. G. Chace, the resident engineer: Increase of headrace capacity, addition to the electrical equipment of the power house by the addition of four machines to be driven by the two turbines now in place, and the installation of a complete new hydro-electric unit. Work on the increase of headrace capacity was begun in July last, and, delayed by reason of the severe winter, is now completed. It will provide for 8,000 h.p.; and excavation for the reception of the new turbine is also nearing completion. Additions to the forebay house covering two additional penstock inlets have been made; a new double track through

skew-plate girder bridge 100 feet long spans the enlarged intake, and will be supplemented by a new highway bridge, to be placed nearer the river margin. Within the power house the two old turbines, 45-inch New American wheels, installed by Wm. Kennedy & Sons, Limited, of Owen Sound, in 1893, have been overhauled thoroughly. One, being now fitted with balanced cylinder gate, has been placed under control of a Sturgess No. 2 hydraulic governor. The working head on both wheels has been slightly increased by deepening the wheel-pit and lowering its outlet; and, as said above, three 200 k.w., d.c. generators and one bipolar booster are being installed in place of two a.c. generators removed. The new hydro-electric unit referred to consists of a 60-inch single downward discharge turbine, now being built by the Jenckes Machine Co., of Sherbrooke, P.Q., direct connection by a vertical shaft to a 1,500 k.w. 175 R.P.M. 500 volt d.c. generator, under construction by the General Electric Co., of Schenectady, N.Y. The turbine will be supplied with water through a steel penstock set in concrete at the forebay side of the wheel-pit, and will discharge through a draft tube to the passage beneath the old turbines. The generator will be supported by a concrete arch which will span the pit at the level of the power house floor.

INDUSTRIAL NOTES.

A new tie mill is being erected at Keewatin.

An oatmeal mill at Minnedosa, Man., is a probability.

Wilson & Just are erecting a machine shop at Treherne.

F. Beard, of Strathcona, is arranging to build a tannery at Prince Albert, N.W.T.

The Lethbridge Iron Works Co. has been incorporated in the North-West Territories.

I. S. Snider and Peter Rempel have decided upon the erection of a 125-barrel flour mill at Morden.

The Frontenac Cereal Co., of Kingston, is negotiating for a five-story factory at Victoria, B.C.

Baird Bros., furniture manufacturers, recently burned out at Plattsville, Ont., will rebuild there.

Bracebridge will take $15,000 preferred stock in the Hess Furniture Co. to induce them to locate there.

The Dominion Iron and Steel Co.'s rod mill at Sydney, C.B., is now in operation. It has a capacity of 200 tons a day.

The James Robertson Co., of Montreal, is considering establishing a branch of the Dominion Saw Works at Vancouver.

St. Catharines will bonus the J. M. Ross Sons & Co., of Brampton, manufacturers of traction engines, crank separators and harvesting machinery.

Sheldon & Sheldon have bought out the McEachren Heating and Ventilating Co. at Galt, and J. D. McEachren has established similar works.

The J. H. Ashdown Hardware Co., of Winnipeg, has been licensed to carry on business in British Columbia; head office, Nelson; capital, $1,000,000.

C. Kloepfer is building a new factory at Guelph for the manufacture of carriage woodware. It will be 112 x 50 feet, three stories and basement, with boiler-house 30 x 30, pressed brick with stone foundation.

The Percival Plow and Stove Co. have recently installed in their works at Merrickville, Ont., a standard 18-inch and a deep bucket 28-inch "Little Giant" turbine, procured from J. C. Wilson & Co., Glenora, Ont.

The Canadian Bullock Electric Manufacturing Company has changed its name to Allis-Chalmers-Bullock, Limited, increased its capital from $1,000,000 to $1,250,000, and extended its business to include all kinds of machinery.

Some Ontario capitalists, whose names are not announced, have secured a large contract for ties in connection with the Panama Canal, and will build a sawmill at Vancouver to cost about $1,000,000.

The Inglewood Pulp Co. will build several sawmills at Musquash, N.B. They are compelled to do this because bush fires have burnt over a large part of their limits, and the timber must be converted into merchantable timber at once.

The Ottawa Furnace and F[illegible] [illegible] increased its capital from $40,000 to $250,000.

The Keller Heater Co. of Canada, incorporated [illegible] Ontario, has increased its capital from $100,000 to $250,000.

The mortgage on the Sault Ste. Marie [illegible] has been paid and the works turned over to the new company, which will soon have them in operation.

Contracts for the Petrie machine shops at [illegible] have been awarded as follows: Roofing, James [illegible]; mason work, George E. Mills; carpenter work, P[illegible] Bros.; painting, Ross Bros.

The Mansfield Glass Works, of New York, with a capital of $200,000, and employing about 150 men, have decided to establish a Canadian branch at Hamilton. They will make lamp chimneys, milk bottles, gem jars and other bottle goods.

The British Columbia Association of Stationary Engineers was recently incorporated under the Benevolent Societies Act of that province. The first board of trustees is composed of William Henry Paddon, William Alexander Robertson, George Henry Fowler, James Johnston Currie, and William Reese, the first four of Vancouver, and the fifth of New Westminster.

The Toronto Type Foundry Co., of Toronto and Montreal, has purchased the plant and business of the Linotype Company, of Montreal. The extent of the business is shown by the fact that last year forty linotype machines, of a value of over $3,000 each, were shipped from Montreal to Belgium, New South Wales, and Queensland, and over fifty machines were sold to Canadian printers.

SCHOOL FOR NATURE STUDY.

The Macdonald Institute at the Ontario Agricultural College, Guelph, will provide a summer school for teachers during the coming vacation. The term will extend from July 5th to July 29th, inclusive, and the work will consist of practical nature study suitable for our public schools. The classes will be under the direction of Dr. W. H. Muldrew of the Macdonald Institute, and Professor William Lochead, of the Biological Department in the Ontario Agricultural College, assisted by teachers in the various special subjects of the course. This course will involve daily excursions, lectures and laboratory work, the preparation of nature study collections and courses of reading in illustration of the subjects discussed.

CATARACT POWER COMPANY'S NEW ENGINES AT HAMILTON.

The Goldie & McCulloch Co., of Galt, recently installed two cross compound non-condensing engines for the Cataract Power, Light and Traction Co., of that city. Some detailed description of these engines will be of interest. The following are the principal dimensions of the engine: Rated horse power, 1,500 h.p.; maximum horse power, 2,250 h.p.; initial pressure, 150 lbs. per sq. in.; diameter of h.p. cylinder, 28 inches; diameter of L.P. cylinder, 52 inches; stroke, 48 inches; speed, 100 revolutions per minute; piston speed, 708 feet per minute; diameter of piston rods, 5½ inches; size of crosshead pin, 7 inches diameter x 9½ inches long; size of crank pin, 8½ inches x 9½ inches long; size of main bearing, 22 inches x 38 inches long; diameter of fly wheel, 18 feet; weight of fly wheel, 120,000 pounds; total weight of engine, 300,000 pounds.

The engines are each direct connected to Westinghouse engine-type alternate current generators. These generators are of 1,000 kilowatt capacity, and 8,000 alternations at 100 revolutions per minute.

This plant is of special interest from the high frequency of the generators, and the fact that they are run in parallel with each other, and also with water turbine driven alternators at the company's main power station thirty miles distant.

The valve gear of these engines embodies several novel features. The valves are of the flat grid-iron type, and are

seated on removable plugs, which are ground into the cylinder. This allows of the valves and seats being scraped to true surfaces, reducing the friction to a minimum. The removable feature of the valve seats permits of an easy and rapid renewal in case of wear. This is a matter of great importance in large engines, inasmuch as the re-boring of a valve seat by a portable rig can never be as satisfactory a job as the refitting of a flat surface in a shop where the use of all necessary appliances is obtainable. The valves move across the cylinder, and each valve is actuated by a separate eccentric on a lay shaft running parallel to the cylinder. This shaft is driven from the main shaft by steel gearing. The steam valve trip gear is carried on a substantial bracket on the outer end of which is the dash pot. This dash pot is used for a cushioning effect only, the actual closing of the valve being obtained in a very rapid manner by the unbalanced steam pressure on the valve spindle. This rapidity of closing permits the valve gear to be run at rotative speeds up to 150 revolutions per minute. The exhaust valves are worked by a combination of links which gives a very rapid opening and closing of the valve and a dwell during the time they are opened or closed. The arrangement of independent eccentrics permits of a long range of cut off, the maximum being seventy-five per cent. of the stroke. In consequence of the valves being of the multi-ported type, with large surfaces, the wear is extremely small, and the valve faces being horizontal perfect lubrication is assured. By placing the valves at the corners of the cylinders the clearance is reduced to a minimum while getting ample port area for high piston speeds.

The Hamilton Bridge Works Company furnished practically all the steelwork of the power-house and transformer houses, both at Hamilton and DeCew Falls, and built the first line of steel pipe for conveying water from the top of the mountain to the wheel pit.

THE WORLD'S FAIR AT ST. LOUIS.

Through the courtesy of the Grand Trunk Railway and the Illinois Central Railway the Press Association of the Province of Quebec and the Canadian Press Association of Ontario visited the Louisiana Purchase Exposition, May 14th, returning on May 21st. The gentlemen in charge of the transportation of the 200 odd members and their wives who made up the party were Messrs. Charlton, McDonald, Quick and Elliott, of the Grand Trunk Railway. Mr. Louis Larivé, the official Canadian Government's correspondent, with headquarters at St. Louis, also accompanied the party. The arrangements made could not have been excelled, the special Pullmans being new from the shops.

The Louisiana Purchase Exposition, in the opinion of the party, had not been overestimated. St. Louis, with its 1,600 acres of Fair site, has larger buildings, more complete arrangements, and in handling the proposition it has profited by the object lessons furnished by Chicago, Buffalo, Glasgow, and Paris; it has also had more liberal support from the various nations abroad, whose buildings and exhibits are far in advance, both in quantity and quality, of those of any previous American World's Fair.

It is said the total cost of the Exhibition will exceed $50,000,000. When one stops to think that in 1803 the United States Government bought this wedge of land, which had New Orleans for its apex and North-western Canada for its base, for $15,000,000, and that the cost of the Exposition will thus exceed by $35,000,000 the price of the territory the purchase of which is marked by this anniversary, one has a slight idea of the progress made by our friends over the border in the last 100 years.

To the readers of the Canadian Engineer there are four buildings which will be of particular interest, and in which our representative spent most of his time, namely, the Transportation, Machinery, Electricity, and Mines and Metallurgy. These buildings are within easy reach of one another; and the Intramural Railway, with its fourteen miles of tracks and quick service, and which has seventeen stations on the grounds, is certainly the easiest means of reaching any given point, for there are no less than thirty-five miles of roadway, and every style of conveyance that can be imagined plying on the same. The Transportation Palace contains four miles of standard gauge railroad tracks, with exhibits from all over the world of land, water and air methods of transportation all represented. Locomotive tests, automobile speed contests, etc., are features of interest. In the Palace of Machinery, the boilers and engines are all exhibits, and 50,000 h.p. supplies the motive power for the exhibitors' machines located in the building. The Palace of Electricity and Machinery contains modern types of machines for the generation and utilization of electrical energy, and Germany, Great Britain, France and the United States vie with each other in representing the latest types. The Mines and Metallurgy Palace, with its outdoor exhibit, covers twenty-one acres; and particular attention is attracted to the model coal mines in operation, as well as the methods used for extracting metal from ore, and the process of manufacturing these metals into the finished product. Pages could be covered with details regarding the foregoing, but space does not permit. The amusement end of the Exposition is called The Pike, and these attractions are located on both sides of a wide vitrified brick boulevard, a mile long; and through the courtesy of the Press and Publicity Bureau the visitors were supplied with passes which were honored at each and every one of the different attractions, which are greater and of a more varied character than one would imagine. On the return trip presentations of valuable plate and jewellery were made by the Ontario contingent to Messrs. Charlton and McDonald, and each association presented its secretary with a handsome souvenir as a recognition of their splendid work, both prior to and during the trip. On the way back ten hours were spent in Chicago, and a banquet was tendered the Associations at the Victoria Hotel, by the Miehle Printing Press Mfg. Co., and at the King Edward in Toronto Mr. James Harper presented Mr. Charlton with a handsome diamond ring from the Press Association of the Province of Quebec. Mr. Harper, secretary of the Press Association of the Province of Quebec, was in addition congratulated on the beautiful badge worn by the members of his association. This was easily the most handsome worn by any of the numerous associations from all over the world who attended the Parliament of the National Editorial Association during the Press Week. With the largest hotel in the world situated within the grounds, the Inside Inn, and the other accommodations provided by St. Louis, visitors to that city should not experience any inconvenience in securing accommodation within reach of their means; and, while June and July may not be ideal months in which to visit the Fair, no doubt many readers of the Canadian Engineer will find it profitable to visit it during the coming five months. This paper has received invitations from many exhibitors who will extend a courteous reception to those of our readers who will mention the name of the paper. No Canadian paper has as many advertisers represented at the Exposition as the Canadian Engineer.

MINING MATTERS.

The Salernos sailed from Sydney last month with a cargo of 5,000 tons of steel from the D. I. & S. Co., for Glasgow.

J. M. Bell is to be sent by the Ontario Government to make further examination of the iron deposits in Michipicoten district.

Power states that an alloy of iron with 36 per cent. nickel is so slightly susceptible to expansion from heat that the expansion can scarcely be measured by the most delicate instruments.

The McGill College mining class, on their annual tour, first visited Copper Cliff, where they spent three days studying geology under Prof. Adams, and two days on metallurgy under Dr. Stansfield. They visited the various mines and smelters. They then went on to Lethbridge, where Dr. Porter took charge of them for the rest of the trip.

It is expected that Prof. Coleman, of Toronto, will complete his examination of the Sudbury nickel area this season. A report and map will then be published of the entire region.

An extensive deposit of coal has been found in Alaska convenient to the Pacific Ocean, and near the Controller oil fields. The coal and oil are found in two distinctly separate formations that lie in roughly parallel belts. The coal area includes about 85 square miles. The coal resembles the harder bituminous coals of the East more than it does anthracite.

The new steel dredge built at Lillooet will soon begin operating on the Fraser River bars. This dredge is the largest of the kind in Canada, and was constructed at a cost of $87,000. It has five powerful engines, and is most completely equipped in every particular to meet the special requirements of gold dredging on a river where the current is very strong.

The Mic-Mac Gold Mining Company at Millipsigate, N.S., has been putting in new machinery, and a new boiler and air compressor. It has bought a water power at Port Medway River, and it is the intention to run the plant and light the mine by electricity. The shaft is four hundred feet deep, a 10-stamp mill on the ground is used for crushing the ore, and it is the intention to add five more stamps.

A company is stated to have been formed by H. M. Whitney, of Boston, and B. F. Pearson, of Halifax, both of whom were promoters of the Dominion Coal and Dominion Iron and Steel Companies at Sydney, whereby they have secured control of coal properties at Inverness Mines, Port Hood and Chimney Corner, in the County of Inverness, together with the railroads now being operated there in connection with these mines. Very extensive developments are expected.

Canada's exhibit of minerals at St. Louis is said to be very fine. The display is the largest ever made by this country at any exhibition. It occupies a space of 9,000 square feet. As Canada supplies more than one-half the world's production of nickel and 95 per cent. of the asbestos, these two ores are given a prominent place. They are displayed in the form of large pyramids. The pyramid of nickel weighs 17 tons, and that of asbestos weighs 14 tons. Two other pyramids are shown, one of corundum, weighing 15 tons, and another of mica. These pyramids illustrate the processes the ores undergo in the transition from the crude state to the finished product. Coal holds a prominent place in the display. Specimens are shown from all fields, from Nova Scotia on the Atlantic to Vancouver Island on the Pacific. Most of the coal used by the Pacific squadron of the United States navy comes from the Vancouver mines. Gold copper ores and silver lead ores are shown in large quantities, as are also chrome iron and manganese iron ore. Seventy-five table cases contain minerals arranged according to their geographical location.

Hydraulic mining is very active this season in the Cariboo country, B.C. In one case a shaft has been sunk through rock a distance of over 300 feet, and from thence a drift was run several hundred feet in bedrock. The real work began, however, where the gravel was tapped, and the problem presented itself of dealing with an enormous pressure of water then encountered. For several months powerful pumps, throwing a thousand gallons per minute, have been at work in the mine, and, although the pressure has been considerably reduced, some time must elapse before it will be possible to attempt to mine the gravel. That is really the problem, how long will it take to get rid of the water, and will the funds last out until this is accomplished. As a Cariboo mine manager remarked: "Either we have one of the biggest things in British Columbia, or we lose all, our work, our time, our money." To him loss would be a serious blow, for he has spent thirteen years of the best years of his life in the undertaking. There is no question that the values are in the gravel, for the best possible prospects have been obtained, some gravel taken out last fall yielding half an ounce to the cubic yard.

Gold dredging is proving very profitable [illegible] river, B.C.

A concentrator plant is to be installed at t[illegible] Creston, B.C.

The Joggins coal mines, Cumberland Co[illegible] N.S. will go into liquidation.

The Burley Gold Mining Company of Ottawa [illegible] surrendered its charter.

The Pilot Gold Mining Co. are putting in a stamp [illegible] at their property at Ymir.

The Jumbo mine, at Rossland, has purchased eight drill compressors from the Mascot mine.

A milling plant is to be installed by the G[illegible] Creek Mining Co. in the Bull river district, B.C.

In the Lake of the Woods district the National G[illegible] Mining and Milling Company will resume operations.

Coal has been found in Siberia, so that on part of the Trans-Siberian Railway the locomotives burn coal instead of wood.

Coal and iron deposits in proximity have been found in the Nicola Valley, B.C., a country not yet reached by a railway.

Work has been resumed at the Poorman-Tiger group of mines, on Wild Horse Creek divide, B.C., the property of John P. Larson.

The Detroit and Parry Sound Mining Co., incorporated under the laws of South Dakota, has been licensed to do business in Ontario.

The Reliance Gold Mining and Milling Co. is installing a Hendryx process mill, of 50 tons capacity, on their property, near Nelson.

A landslide destroyed plant and machinery at the Silver Cup mine in the Lardeau, valued at $250,000. Slides also damaged a number of buildings at the Slocan Star.

A few days will probably see machinery started at Rossland Power Company's two hundred ton concentrator, and the works will be soon crushing to their full capacity.

The American Cement Company has purchased the property of the International Asbestos Co., and intend pushing with vigor the manufacture of their product at Actinolite, Ont.

In the marble quarries, of Carrara, the greatest single blasting operation ever undertaken there has been successfully accomplished, resulting in the loosening of a huge block of marble valued at £12,000.

The output of the Dominion Coal Co. is now 13,000 tons a day, reaching some days 14,500. A large proportion, at least 7,000 to 8,000 tons a day, is shipped to the St. Lawrence. More than 3,000,000 tons have been sold in advance.

Advices from Keewatin state that there are gratifying indications of a revival in gold mining operations in the district. The investments of United States capitalists have been so satisfactory that others are preparing to follow.

Extensive improvements have been made at Port Morien in the Newcastle Collieries Co.'s mine, with a view of increasing the coal output. A Rand air compressor and two 500-h.p. Babcock & Wilcox boilers are among the improvements.

The Canadian Pacific has closed a contract to carry 15,000 tons of lead ore from the Kootenay district of British Columbia to England. They have also made contracts for the shipment of large quantities of copper ore from the Sudbury district.

A movement is on foot looking to the [illegible] and development of the copper bearing properties in the Eastern Townships. Under present conditions, the [illegible] shipped for treatment to Staten Island, N.Y., [illegible] smelter and chemical works at Sherbrooke is contemplated.

A ten stamp mill has been put in operation [illegible] Cameron Island [illegible], four miles [illegible] the owners of the Indian Joe mine, three miles [illegible] Mikado, are ordering a mill, and development work [illegible] Olympia mine, a mile south of the Mikado, has shown [illegible] ore.

MUNICIPAL WORKS, ETC.

Carroll, Man., is to have a new $6,000 bridge.

Almonte will spend $7,000 on granolithic sidewalks this year.

Kingston has eight miles of granolithic walks and Brockville thirteen.

Listowel has authorized the borrowing of $10,000 to complete the waterworks, $21,000 raised by last year's by-law being insufficient.

Peter Lyall & Son, of Montreal, have been awarded the contract for the new Ottawa University buildings, the steel wharf sheds at Montreal, and the C.P.R. station and hotel at Winnipeg.

Barrie will issue debentures for the following improvements: Extending cement pavements, $10,000; extending water works system, $3,000; enlarging fire hall, $3,500; purchase of hose, $1,500.

An official report of the Department of Bridges and Roads in France shows the continuance of good results in rendering roads free from dust by coating the surface with tar. This was tried after the unsuccessful use of a mixture of oil and petroleum. The engineer says: In La Cher two lengths of the Chausée Nationale were coated with tar in June and August of 1902. Both these experiments have been entirely successful, the road now being covered with an elastic skin, while the sound of foot-passengers' tread is muffled and horses and draught oxen require only one-half the effort they put forth before. The noise and vibration caused by vehicular traffic is much reduced, and neither dust nor mud is formed on the tarred surface.

Montreal is having considerable difficulty in connection with the drainage of St. Denis ward, and the northern portions of the city. When the city established a sewage farm and a drainage system leading from it to the Back river, two or three years ago, it was supposed a work had been done which would last for years, but the original plans were altered, so that the surface water, as well as sewage, should pass through the farm. The city surveyor pointed out at the time that this was a mistake, as the farm would be unable to filter such a quantity of water, and it would become flooded and choked. So it has turned out, and the courts have forbidden the use of the farm and drains, as they were creating a nuisance. A report on the means to be employed to overcome the difficulty has been prepared by the city surveyor's department, several alterations being suggested, but before deciding on any one, the municipalities of St. Louis and Outremont, which are specially affected, are to be consulted.

C. H. Rust, Toronto city engineer, recently explained to the Provincial Board of Health the three systems of sewage disposal which he suggests as feasible, with the object of eliciting an authoritative expression of opinion as to the most suitable. Scheme 1 is the carrying of the crude sewage to an outlet in the lake, nine miles east of the waterworks intake pipe. This would cost $1,750,000, with an annual cost, without interest, of $17,000. Scheme 2 is to convey the sewage of Woodbine Ave., treat it by septic tanks and pump the effluent to a sandy farm of 700 acres, north of Danforth Ave. This would cost $2,400,000, and its maintenance would be $76,000. Scheme 3 is to supply septic tanks and bacteria beds on Ashbridge's Marsh, and turn the effluent into the lake. This would cost $2,500,000, and the maintenance would be $37,000. Personally, the Engineer favors scheme No. 1, but it is opposed by Dr. Sheard, Medical Health Officer. Mr. Rust's next choice would be scheme No. 2, the sewage farm plan, although it would be a most expensive one. The other scheme, the placing of septic tanks on Ashbridge's Marsh, would cause a great deal of objection by people residing in the vicinity. Dr. Sheard said he could not approve of turning the crude sewage into the lake. The prevailing winds would be easterly, and would drive the sewage towards the waterworks intake, besides polluting the shore near the sewage outlet. In his opinion the sewage should be treated by septic tanks. He insisted on a pure effluent, no matter what the cost of the system adopted. The matter was referred to the Sewage Disposal Committee of the Board.

A by-law to raise $10,000 to extend the waterworks and electric light plants has been defeated in Strathroy.

A party has left Vancouver to commence the Alaska boundary survey. The work is expected to extend over three years.

Winnipeg will purchase a water tower and an aerial ladder, increase the apparatus at the halls, and build a new fire hall at a cost of $17,000.

The Maritime Contracting and Mining Co. has the contract for the Springhill, N.S., waterworks. The reservoir will be built on the summit of Cobequid Mountain, about seven miles from Springhill. The system will cost in the vicinity of $100,000.

The Canada Foundry Company was awarded the contract for the new steel conduit across the bay at Toronto. Its tender was $14.96 per lineal foot, or 48 cents in advance of the offer made by the Pittsburg firm of James McNeil & Co. The distance is nearly 6,000 feet.

Motor water carts, each carrying 1,100 gallons, have proved successful in Paris. The sprinkling apparatus is connected with the wheels so that water is delivered at a rate corresponding to the speed of the cart, and stops when the cart comes to a standstill.

The Dominion Government will erect such fortifications in the harbor of St. John, N.B., as will enable the port to defend itself against attack from the sea. The chief battery will be built this season upon the highest ground of Partridge Island, which may necessitate changing the site of the present lighthouse. Lord Dundonald is anxious also to have batteries erected to protect the harbor of Vancouver, B.C.

The Canadian Fire Underwriters' Association declare that extensive improvements are required in the Montreal waterworks. The pumping capacity is ten millions of gallons short per day. A fifteen million gallon steam plant for low level is urged; new boilers to take the place of three which have been condemned; two six million gallon pumps at high level, one for service and one in reserve; six more steam fire engines, one of 1,300 and five of 1,000 gallons; additional hose, extension ladders, trucks, chemical engines, hydrants, signal boxes and extended water mains.

The Ontario Public Works Department has purchased from a Hamilton firm five road-grading machines. Two will be placed in the Parry Sound district, one in Algoma, one in Thunder Bay, and one in the Rainy River district. In the past all the colonization roads have been made with pick and shovel, and it is expected that with the graders not only will the work be more cheaply done, but also more satisfactorily. During the past winter about 60 miles of road were cleared in the Temiskaming district, the work of stumping with dynamite has commenced, and this will be immediately followed by the graders.

TORONTO ENGINEERS' CLUB.

Two meetings of the Toronto Engineers' Club were held in May. On the 12th, Henry Wiederhold, of Philadelphia, read a paper on "Rock and Mastic Asphalts," and on the 26th, A. G. Christie read one on "Steam Turbine Testing at the Westinghouse Works, Pittsburg, Penn." Both were illustrated by lantern slides, and were of a technical character, but full of interest to engineers.

—The Egyptian Government has given the firm of Sir William Arrol & Co., the builders of the Forth and Tay bridges, the contract for the construction of three bridges across the Nile, near Cairo, at a cost of about £200,000. Thirty-four tenders in all were sent in from Great Britain, France, Germany, Italy, America, Switzerland and Belgium. Hitherto, owing to the high tenders made by British firms, the chief contracts in Egypt have gone to French firms. Two of the new bridges will be comparatively small, being be 600 yards long and 65 feet broad. The French firm of MM. Dayde & Pillet, which closely competed, has been awarded the work of constructing two railway bridges in the Delta.

PERSONAL.

C. B. Brown, resident engineer of the C.P.R. at London, with his staff of four men, has been transferred to Toronto.

John Croft, who was terribly injured while dynamiting among the fire ruins at Toronto, died at the Emergency Hospital a few hours after being admitted.

T. H. Wiggins, C.E., has been appointed by the North-West Government to take charge of drainage and irrigation work in the Territories, in succession to B. J. Saunders, who resigned. Both are Brockville men.

The sudden death is announced of T. S. Ingraham, first assistant grand chief engineer of the International Brotherhood of Railway Engineers, who dropped dead at his desk at the convention at Los Angeles, May 27th, from apoplexy.

Josiah Dawson, of St. Catharines, one of the best-known marine engineers on the Great Lakes, is dead. He was engineer of the Lakeside, running between Toronto and St. Catharines. A son was lost when the Bannockburn went down.

W. N. Dietrich, an electrical engineer with the C.P.R., jumped off a train near Rat Portage, which was running at a good rate of speed, to rescue a baby which had fallen off the train. Finding it comparatively unhurt, he followed to Winnipeg on the second section of the train and restored it to its frantic mother.

Frank G. Stevens, of Halifax, N.S., who has been superintendent of Le Roi No. 2 mine at Rossland, B.C., has resigned to take the superintendency of large gold and silver mines at Guanajuato, Mexico. He is succeeded by D. R Thomas. Mr. Stevens is a graduate of Kingston School of Mines.

J. A. McGregor has been appointed assistant superintendent of the C.P.R. car service, with headquarters in Winnipeg. His division extends from Fort William to the Pacific coast. J. Edickson, superintendent at White River, has been promoted to superintendent of the second section of the western division with headquarters at Cranbrook. W K. Thompson, of Toronto, has been appointed superintendent at White River.

E. H. Henry, recently chief engineer of the Canadian Pacific Railway, and formerly of the Northern Pacific, has been appointed fourth vice-president of the New York, New Haven, and Hartford Railway Company, a new position, the duties of which are to cover the construction, maintenance, and operation of the company's lines operated by electricity. Mr. McHenry will assume the duties July 1st, with headquarters at New Haven, reporting to President Mellen.

Antoine Gobeil, Deputy Minister of Public Works at Ottawa, contemplates, rumor says, retiring from that position and taking up the practice of his profession, that of law. He was born at St. Jean, on the Isle of Orleans, in 1853, and has been in the Public Works Department for thirty-two years, for the last thirteen of which he has been Deputy Minister, holding that position under Sir Hector Langevin, Hon. J. A. Ouimet, Hon. Alphonse Desjardins, Hon. J. I. Tarte and Hon. James Sutherland.

H. W. Breckenridge, secretary-treasurer of the Colburn Machine Tool Co., Franklin, Pa., had an unpleasant experience with a burglar on the night of May 10th, being shot twice in the left side after a heroic struggle with the intruder. The burglar escaped and has not yet been captured. Mr. Breckenridge, who is possessed of a good constitution, has almost recovered. Meantime a big reward has been offered for the capture of the offender, both by the city and private parties, and Mr. Breckenridge's many friends in Canada congratulate him on his plucky defence of his home.

Last month we stated that W. F. Tye would probably succeed E. H. McHenry as chief engineer of the Canadian Pacific Railway. Since then the appointment has been made. Mr. Tye is about 43 years of age. He was educated at the Ottawa University and the School of Practical Science, Toronto, and entered railway service in 1882, acting as rodman, leveller and transitman successively on location, and afterwards [illegible] C.P.R. In 188[illegible] and 1887, he was transferred [illegible] engineer on the St. Paul, Minneapolis and [illegible] next year he served as engineer of track [illegible] Tampico branch of the Mexican Central. In 18[illegible] locating engineer of the Great Falls and Canada R[illegible] Montana, and in 1891 and 1892 engineer in charge [illegible]tion and division engineer of the Pacific extension [illegible] Great Northern. For about two years he was in charge of the change of gage of the Alberta Railway and Coal Company's road. In 1895 he was chief engineer of the Kaslo and Slocan Railway, and for four years he held a similar position on the Columbia and Western. In 1900 he became chief engineer of construction of the Canadian Pacific, and in June, 1902, was appointed assistant chief engineer of the system, which position he held till his recent promotion.

John G. Bain, president-elect of the Ontario Association of Stationary Engineers, is no stranger to steam engineers throughout Ontario and adjacent provinces. He has held positions in private, municipal, and railway steam and water plants, and in one case was for fifteen years in the employ of a prominent printing establishment in Toronto. He was also in charge of the first electric light plant installed in Toronto, and while about 6 years ago, on account of his health, he entered the employ of one of the prominent oil companies, as traveller, and was retained on the staff of the new amalgamated independent oil companies, known as the Canadian Oil Co., Limited, he has always been closely in touch with engineering interests. He was secretary for a time of the Canadian Association of Stationary Engineers. He is now recovering from an accident, which happened three months ago, when he was struck by a trolley car and had his skull badly fractured. For many days he was unconscious, and his friends feared the worst from the series of surgical operations he underwent.

The Niles-Bement-Pond Company, Liberty street, New York, have issued a monumental work in the shape of a cloth bound machine tool catalogue of 750 quarto pages. It is said to be the most complete machine tool catalogue published. It opens with six full page illustrations of the various works of the Niles-Bement-Pond Company, and following these are thirteen pages of medals and diplomas awarded the various constituent companies of this concern. The first machines described are those for railroad shop use, including a complete line of driving wheel lathes, car-wheel lathes, a large variety of axle lathes, cutting-off and centering machines, quartering machines, car-wheel borers and hydrostatic wheel presses. The next division of the catalogue is devoted to lathes, including all sizes from the Pratt & Whitney bench lathe to the massive Bement 125-inch crank shaft lathe. Fifty pages are devoted to planing machines, and a specially large variety of heavy planers are shown. A large number of heavy drills are shown, including vertical drills, radial drills and multiple drills. Among the most interesting pages are those devoted to boring machines. First are the horizontal boring machines, which include all varieties of boring machines in which the work remains stationary, the cutting being done

by revolving cutters. A particularly complete line of floor boring machines or horizontal boring, drilling and milling machines are shown, including every conceivable variety of these machines. Fifty pages are devoted to boring and turning mills. Following the section on boring and turning mills are a few pages devoted to miscellaneous machine tools, and then comes a very complete line of boiler shop machinery, including plate planers, bending rolls, punching and shearing machines, hydraulic presses, steam and hydraulic riveters. In the latter part of the catalogue the full line of Bement steam hammers is illustrated, together with a number of installations of Niles' electric travelling cranes. The last pages are devoted to the small tools made by Pratt & Whitney Company. Some idea of the size of the book can be obtained from the fact that it weighs about ten pounds, the entire edition amounting to 75 tons of catalogues. Its circulation is limited to users of heavy machine tools.

SAMUEL R. CALLOWAY.

Samuel R. Calloway, president of the American Locomotive Co., and president of the recently formed Locomotive and Machine Co., of Montreal, died last month in New York, aged 54. Mr. Calloway, who was born in Toronto, had a remarkable career of success as a railway man. Beginning life as an apprenticed clerk in the Grand Trunk, he was transferred to the office of Sir Joseph Hickson, then secretary of the company, from which position his rise was rapid. In 1874 he became superintendent of the Detroit and Milwaukee, and ended his railway life as president of the New York Central. This high position he resigned to take the presidency of the two locomotive manufacturing companies, which do business for both halves of the continent. His abilities were said to have been recognized by the highest salary ever paid to a railway official. He was a man of great force of character, and simple in his tastes.

❧ ❧ ❧

The Canada Smelting Co., Montreal, to take over the business of the Canada Smelting Co., and to carry on business as smelters of all kinds of metals; James Lipsky, and others.

Edward S. Hopkins, manager of the D'Olier Engineering Co., New York, sales agents of the DeLaval Steam Turbine, visited Canada during the past month, and was impressed with the possibilities afforded for trade in his line in the Dominion. It is possible that his firm will shortly open up offices in Canada.

Sadler & Haworth, manufacturers of leather belting, Montreal and Toronto, were the successful tenderers for the order for leather belting for the International Portland Cement Co., of Ottawa and Toronto, to be used in their new plant at Hull, Que. The order amounted to about 7,000 feet of both single and double belting. The company's Durham plant had previously been supplied with Sadler & Haworth belting.

Peterboro [illegible] has passed a by-law granting a [illegible]-year franchise to the Canadian Machine Telephone Co. In the business streets the wires are to be placed underground and [illegible] to be in working order within twelve months. [illegible] not to exceed $15 for private houses, $20 a year [illegible] of business, [illegible] for house and place of business. [illegible] Ottawa [illegible] in favor of giving a franchise to the same company.

T. AND H. SEVEN KILOWATT DYNAMO.

The accompanying cut illustrates a dynamo of seven kilowatt capacity, built by the Toronto and Hamilton Electric Co., direct connected to a 5¾ x 6 Racine engine. The machine is especially designed for steamboat lighting and other places where small floor space is used, and the absence of belts is an important consideration. The engine is of the centre crank type, and is entirely enclosed, to prevent splashing of oil or water on the windings. Regulation is guaranteed within 1½ per cent. from no load to full

load. The lubrication is very perfect owing to the system of sight feed lubricators and oil tubes. The dynamo is the standard multipolar generator, compound wound, using the usual form of wound coils. Ventilation in this machine is excellent, and in operation it is sparkless and cool, even under a heavy overload. The outfit is noted for symmetry, simplicity and efficiency. The same firm have a line of alternate current machinery, which they advertise on another page.

❧ ❧ ❧

The following are additional to the list of steamboat engineers given in the May issue: Corona, Wm. Walsh; Garden City, John Cunningham; Samuel Marshall, R. H. Lawson; Arabian, Jas. H. Brown; Neepawah, Robt. Duguid; Wahcondah, R. W. Ross; Lake Michigan, J. Hamlin.

The Canadian Westinghouse Company, Limited, of Hamilton, have sold to the Northern Electric and Manufacturing Co., Limited, of Montreal, Que., manufacturers of telephone apparatus, a 300 kw. steam turbine unit, consisting of a Westinghouse-Parsons turbine and a Westinghouse turbo-alternator.

—There will be an international electrical congress in the World's Fair grounds at St. Louis, from the 12th to 17th September. The last world's congress of electricians was held at the Paris Exposition in 1900. The coming congress will be in the week just preceding the proposed Scientific congress at St. Louis. It has been arranged so that visiting electricians may attend the ceremony of dedicating the Bureau of Electrical Standards at Washington, at which President Roosevelt will officiate. The electrical congress will be divided into sections, comprising the following subjects on which papers will be read by prominent men. In general theory: Mathematical, Experimental. Applications: General Applications, Electrochemistry, Electric Power Transmission, Electric Light and Distribution, Electric Transportation, Electric Communication, Electrotherapeutics. Among the associations that are expected to take part are: The American Institute of Electrical Engineers, the American Electrochemical Society, the National Electric Light Association, the Association of Edison Illuminating Companies, the Pacific Coast Transmission Association, the American Electrotherapeutic Association. It is also hoped to secure the participation of scientific societies. Prof. A. E. Kennelly, of Harvard University, Cambridge, Mass., is organizing secretary, from whom terms of the membership fee for this convention may be obtained. Prof. H. T. Barnes, of McGill University, Montreal, is on the committee of organization.

MECHANICAL WOOD PULP.*

By Stanislas Gagne, B.A., Sc.

(Continued from last issue.)

Grinding.—What constitutes the mechanical process of "pulping" wood is the grinding operation instead of a "cooking" with chemicals; hence if mechanical wood pulp is badly ground it will be inferior in quality no matter how well other operations have been performed. We have seen before that wood is an agglomeration of fibres, and the object of grinding is to derive from that agglomeration a pulp or a soft mass of particles that will have the proper qualities for paper making, namely, that it will be long, thin, flexible and felt well. To attain this end we have several kinds of grinders which differ but little in principle. Fig. 12 illustrates the principle of an ordinary grinder. We have first a stone A, against which the sticks or bolts of wood, with their longitudinal axes parallel to the shaft turning the stone, are pressed in pockets B. by hydraulic pressure on pistons C. in cylinders D. These stones, which must be composed of very small and sharp grains and have a certain strength to resist the centrifugal force caused by revolving at a high speed, are quarried out of sand stone and turned to required diameters. Some good stones are quarried in Nova Scotia, but the best ones are said to be those derived from certain districts in England.

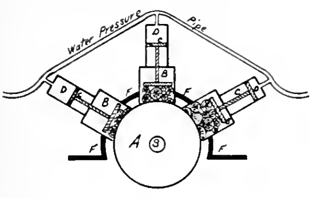


Fig 12

Sectional Elevation of GRINDER
A, stone; B, pocket; C, piston; D, cylinder; F, frame; S, shaft.

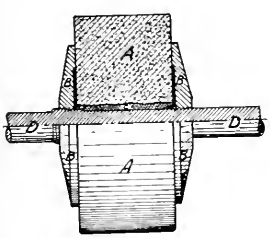


Fig 13 STONE & FLANGES

A, stone; B, flanges; C. Cement; D, shaft.

Grinders.—Taking the Port Henry Grinder, built by the Jenckes Machine Co., of Sherbrooke, Que., as a typical example of the kind which is used in Canada, the following is a general description of the machine: Fig. 18 shows a cut of it, and the name of the chief parts may be obtained by referring to Fig. 12. The shaft, which is very large, is made of hammered soft steel, and on both sides of the stone are threads on which the flanges are screwed. These flanges, which are about 38 inches in diameter, are faced where they come into contact with the stone (see Fig. 13); threads are cut right and left, and they weigh about 800 lbs. each. This grinder, which is so made as to take stones from 50 to 54 inches in diameter, and 18 to 26 inches wide, can grind until the stone is reduced to about 40 inches in diameter. The main shaft boxes or bearings are self-adjustable and quickly conform themselves to any variation in the shaft. The length of the box is about 18 inches, wood lined for bearings in water, or babbitted boxes are sometimes used with them. The pockets are made in oen piece, 2 inches in thickness and can be closely adjusted to the [illegible] pass through un[illegible] 16 inches in diameter, and the tw[illegible], 14 [illegible] diameter, hence the [illegible] largely disp[illegible]. The pockets are [illegible] lowered [illegible] faces, by two 2-inch soft steel screws (S.) The doors for the pockets are of soft steel [illegible] slide up and down in a groove in the pocket. The pocket followers are pr[illegible] with strips cast on the lower side to prevent the wood from rolling in the pockets. The cylinders are made of iron, lined with brass, and have heads accurately fitted to them. The lower heads connect direct to the top of the pocket and are provided with doors on the back and front, which are easily removed when lower packing glands of piston rods require adjusting or re-packing.

Operation of new piping system (patented).—Referring to Fig. 18, suppose the two side pockets are grinding under high pressure, and that one of the side pockets needs refilling; the centre pocket is then idle; but by changing the three-way valve A. the high pressure is thrown on to the centre pocket and causes it to grind under high pressure. The empty side pocket being now relieved, the low pressure of water, automatically opens the check valve and acts upon the piston lifting the pocket follower from the stone. The pocket is then refilled. The valve B. is shifted, allowing the low pressure to bring the piston down until the wood is pressed firmly against the stone. At this point the three-way valve is turned so that the high pressure water is diverted from the

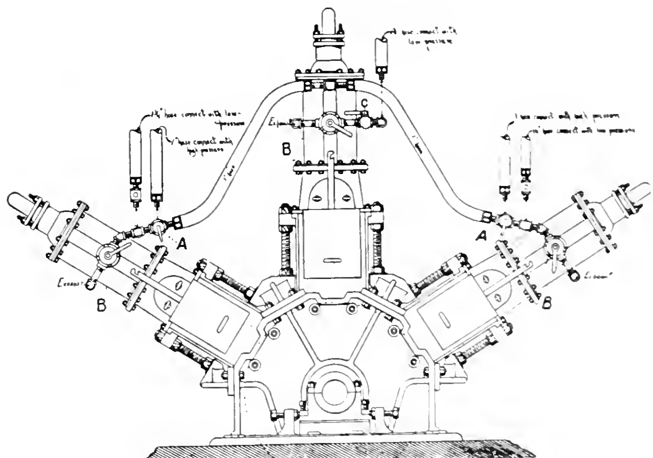


Fig. 18

Fig. 18—Port Henry Pulp Grinder

centre pocket and enters on the top of the piston, at the same time automatically closing the low pressure check valve. The centre pocket is now idle, and if the other side pocket requires refilling, it is done in a manner similar to the above. If not, and if the centre pocket should require refilling, the follower of the centre pocket is lifted from the stone by means of valve B., which is always connected with the lower pressure, the pocket is refilled with the low pressure again introduced into the cylinder above the piston. In this manner, as above stated, the cylinders are always filled with water at a high or low pressure, consequently, when the three-way valves are shifted there is no loss of time before the pockets begin to grind, and the grinder is thus always in action. Fig. 19 is a view of the grinder built by the Waterous Engine Works Co., Limited, of Brantford, Ont. As will be noticed, the general outline is the same as the Port Henry, and differs only from it in details. The grinder built by Carrier, Laine & Co., of Levis, Que., differs from these above mentioned, as seen by Fig. 20. Its construction allows the pulp to remain longer around the stone, which is run with part of the lower side in pulp and water, while those others are usually intended to run clear of the water underneath. The directions of the pressure of the stone of the latter is not the same as

*The above paper won the first prize given by the publishers of the Canadian Engineer for the best student's paper presented to the Canadian Society of Civil Engineers for 1903, the judges being members of the Society.

on those others, more distance being allowed between the pocket. Some objections are made to this method of distributing the pockets, because the horizontal thrust on the bearings from one of the side pockets, when the other is not grinding, is so great that it quickly wears out the bearing; and they say that the more vertical the resultant pressure is the better for the bearing.

OPERATION OF GRINDERS.

STONE SETTING.—Stones usually run direct on the turbine shaft, so as to eliminate the loss of power caused by belting or gearing and are coupled to it by means of two flanges, which screw in opposite directions on the shaft, as described before, and so arranged that the pressure on the revolving stone will tend to tighten the flanges and not loosen them. Care is taken to centre the stone properly, and when the flanges are screwed up tight, cement is poured in around the shaft and between the stone and the flanges, by grooves and holes in the flanges for that purpose, to fill all the space that may be left, so that the stone may be set tightly everywhere.

Some claim that it is an improvement to bolt the stone and flanges by one-inch bolts running through the stone from side to side, their reason being that this adds to the strength and solidity of the stone and prevents it from bursting. Others who have tried them, discarded them because they claim that they cause the stone to break; one reason for this is that the stone is bound to slip sometime when heavy pressure is suddenly applied; this it cannot do if it is bolted tight and the flanges cannot screw any more, and the only alternative left to the stone is to break.

TURNING.—This is done by means of an arrangement represented in Fig. 21. The Fig. B. is pressed against the revolving stone, where it requires turning and is actuated by a screw and hand wheel. The stones are usually thus dressed with a slight crown at the centre, or with the edges slightly rounded off to prevent sprawling of the stone. Great care is taken that no cracks are made in the stone which would cause it to fly when revolving under pressure.

SHARPENING.—This is the next operation and a very delicate one it is. In most cases the value of the pulp depends on the skill with which it is performed, as may readily be seen. A perfect sharpening would be one that the surface of the stone would be composed of a large number of very small sharp points or projections which would detach the fibre one by one. In actual practice opinions vary greatly as to how to produce a good sharpening. In nearly every case a steel jig or burr, about 2-in. wide and 3-in. in diameter, with pyramidal projections numbering 16 to 100 per sq. inch, is used, but it is in the use of that jig that opinions vary so much. Some manufacturers employ two jigs, a close pointed one, so as to make even cuts, being passed over the surface, which is afterwards somewhat smoothened down with a coarser jig. Others make use of but one jig, usually a close, pointed one, which is passed several times over the surface, until the latter is judged in proper shape. What seems to be a reasonable method is to pass a sharp and rather close-pointed jig (with say 100 projections per square inch), quickly across the surface of the revolving stone, so that it will not pass over the same surface twice, thereby causing an even surface of about 100 projections to the square inch on the stone. Dull jigs should not be used as they make pits instead of sharp projections. If the stone has been sharpened too much, a brick or a plane surface stone is used to smoothen it. Some stones will sharpen by use instead of dulling, in which case they must be smoothed instead of sharpened. The frequency of sharpening depends mainly on the quality of the stone and on the speed and pressure used; for an ordinary English stone with a 50 to 75 lbs.' pressure per square inch in the cylinders, and a speed of 225 R.P.M. twice a week in summer and once a day in winter is a fair average. After sharpening, the stone is washed to remove all the loose grains of sand and then is ready for operation. The pockets are filled with wood and turbines started.

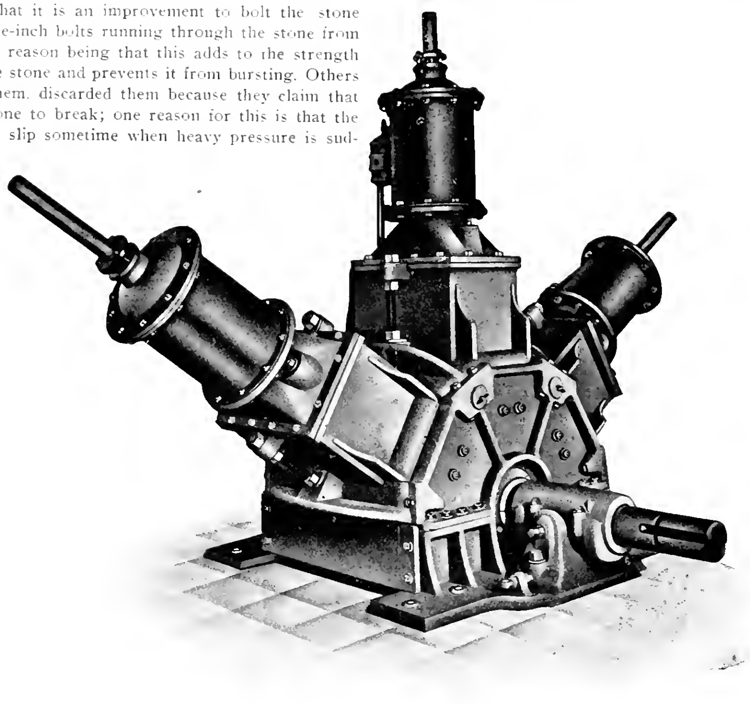
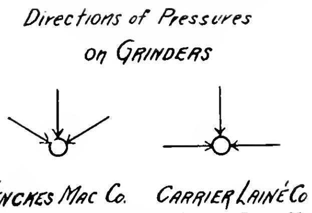


Fig. 19.—New Success Pulp Grinder.

SPEED.—Some maintain that the maximum production of a grinder occurs when the stone revolves at a speed of 175 to 200 R.P.M. while others claim that a speed between 225 and 250 R.P.M. with an ordinary 44 to 50-inch stone produces the best results. Which is right? The result only tells. Assuming the same sharpness of the stone and the same pressure on the wood, the production increases with the speed up to a certain point and then decreases, and the quality of the pulp also increases up to a certain point and then decreases, but the quality is decreasing when the production still continues increasing. If the speed is too low, the pulp will be coarse, and if too high, it will be mealy and short. To find the correct point, both in speed and pressure, a careful examination must be made and several tests of the products must be applied. An ordinary grinder, with a 50-inch stone, using 24-inch bolts and turning at a speed of 200 to 225

R.P.M. with a pressure of 60 to 75 lbs. per square inch in the cylinder, corresponding to a pressure of 15 to 18 lbs. per square inch on the grinding surface, will require 300 to 350-h.p. to produce five tons of air dry pulp per 24 hours. With 500-h.p., a pressure of 100 to 125 lbs. per square inch and 200 R.P.M., it will produce 7 to 8 tons in the same period. The side plates of the pockets should be set down as close to the stone as possible to prevent chips and splinters from passing through unground. The supply of water required to keep the



Approximate direction of pressure in the Port Henry type. Same in the Carrier, Laine & Co., type.

stone at the proper temperature and to wash down the pulp is usually introduced from a spray at the top and must be carefully attended to. When the lower part of the stone runs into a vat partially full of pulp and water, the spray must be just enough to wash the pulp down. This water should be so regulated that the stone is kept at a rather high temperature (about 100 degrees Fah.), which causes the grinding to be more easily accomplished, hence the output to be increased. In cases where the mill is stopped for repairs or for Sunday, care should be taken that the stone is allowed to cool slowly, and, if the lower part runs in water that the water is drained off so that the stone may cool evenly. The reason why stones crack and fly off when running, is resumed and may sometimes be looked for in the neglect of such details. Sometimes the wood jams in the pockets, thus relieving the pres-

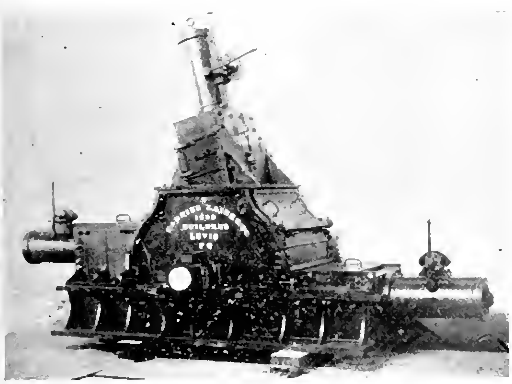


Fig. 20—Pulp grinder, manufactured by Carrier, Laine & Co.

sure on the stone which then ceases grinding the wood in that pocket; in that case it is only necessary to remove the pressure and loosen the wood by means of a short bar. The undersides of the followers should have strips cast on them so as to prevent wood from rolling in the pockets, as seen in the case of the Port Henry grinder. An ordinary good English stone properly handled and operated lasts about a year and wears down in ordinary grinders from 54 to 30 inches. If several stones are coupled directly on the turbine shaft, as in case of Fig. 10, each one has its shaft length, which shafts are all equal and held together by ordinary couplings. All mills should be provided with extra shaft lengths and at least one ready mounted stone; thus, when a stone anywhere on the shaft has to be changed or replaced, the turbines are stopped only the time necessary to uncouple the old stone and replace it with the ready mounted one, which requires but a short time. All grinders used in Canada are of the horizontal running type, as described. In some other countries, however, vertical types are [illegible] the grinding is done [illegible]. Other types have also been [illegible] but so far as the writer knows none has yet proved to be more economical and practical than the present [illegible]

Pumps. At least four sets of pumps are necessary for an ordinary exporting pulp mill: 1st. High pressure pumps for the cylinders of the grinders. 2nd. Low pressure pumps for backing cylinder pistons for sprays on the stones and in screens and wet machines and various other uses. 3rd. Stuff pumps to convey the ground pulp from the tanks under the grinders to the screens, and 4th. High pressure pumps for the presses. In case of a mill deriving its power from a high head, the number of pumps may be reduced to the last two, pressure direct from the flume or water pipe being used instead of the first two.

1st. Pump for Cylinders of Grinders. Ordinary triplex power pumps are used, the sizes varying with the work to be done. At least two are employed and are so arranged that

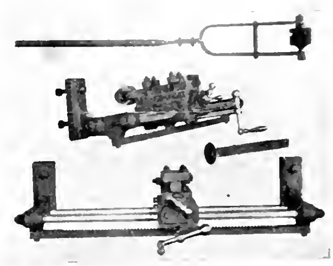


Fig. 21—Stone-turning device for "Success" Pulp Grinder.

if one fails, the other will do the work without any of the grinders being stopped. They are usually driven by means of a belt from the turbine shaft, and thus, the pressure varying with the speed, they will act somewhat as a governor if desired. If a constant pressure is wanted an accumulator is used to regulate it.

2nd. Low Pressure Pumps.—The same type as the one above mentioned, but built lighter will answer the purpose.

3rd. Stuff Pumps.—As the turbines must be set as near the tail race as possible (in most cases not higher than about 15 ft.), the ground pulp must be pumped up to the screen above the wet machines. This wet pulp falls from the grinders into tanks or troughs running along and under the grinders, and is conveyed by gravity to one or several reservoirs from which the stuff pumps take it. On account of the usually low head to be overcome and of their simplicity and freedom from valves, centrifugal pumps are the best adapted for this purpose. Ordinary stuff pumps are sometimes used.

4th. High Pressure Pumps for Presses.—These will be considered later.

(To be continued.)

SMOKE HOOD AND EXHAUST SYSTEM FOR LOCOMOTIVE HOUSES.

Alfred J. Stevens, C.E., and M.E., Toronto, has invented a new method of removing smoke from locomotive houses, which will appeal both to railway managers and municipalities.

This system is designed to replace the Wigwam Jack, now in common use, and to fulfil other ends. It consists essentially of a horizontal main smoke pipe, suspended to the roof and reaching over all the stalls in the house to be served, and provided with swinging, adjustable hoods which fit closely to the stacks of the locomotives. The main pipe is connected to an exhaust fan or chimney, and the smoke is delivered through a single stack at any desired elevation above the engine house or surrounding property.

The application to an engine house of eighteen stalls is shown by Fig. 3. The house is divided into three sections, and the main pipe is reduced in size in each section. The

draft of 1-in. water gauge is usually sufficient, but can readily be reduced on any engine, or increased on the whole system. The pipe (Fig. 3), is connected to an exhaust fan operating the power plant boilers, and is dampered so that the draft on the boilers or in the main pipe can be regulated at will. Another fan may be installed with that of the power boilers, or it may be an independent installation located where desired. The main pipe may be connected to a suitable chimney or stack, and the fan omitted or used as an auxiliary.

The temperature inside the main pipe always being equal to or above that in the house, there will not be any condensation and deposit of dirt over the locomotives. The draft keeps the pipes clean. There always being an inward draft at all openings no fire or smoke can escape. Further, as concrete and other fireproof roofs are now being constructed, or insulation if required could be provided, these questions can be dismissed.

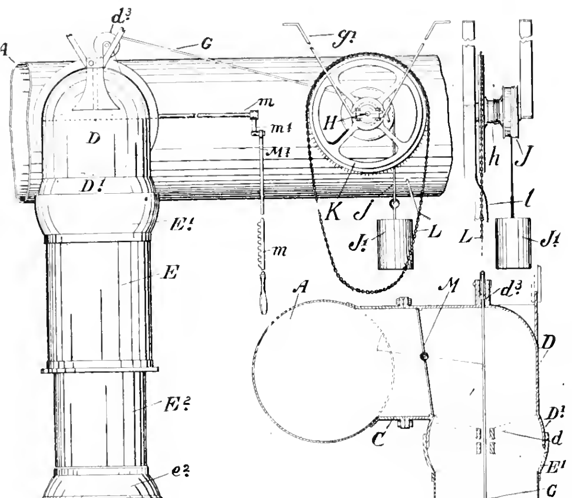


Fig. 1.

Scale ½ inch to Foot

A—Horizontal Main Smoke Pipe. D—An Elbow design to prevent soot falling from the Main Pipe and to reduce the height of the house, thus cheapening the cost of construction. E—E2—Telescopic and Swinging Hood. The lower end is designed to closely fit the locomotive stack. M—An adjustable Damper, designed so its weight and draft will assist in closing it. The damper when closed effectively prevents unnecessary drafts through the Engine, and saves heat and money which escape through the Wigwam Jack. G—A Cord or Chain adjusting the telescopic E2. If found necessary, an auxiliary check chain or stop may be provided. K.H—A Differential Hoisting Wench for adjusting the telescopic part of the Hood. The counter balance weight J1, is designed so as to nearly overcome the weight of the telescopic part E2. Other suitable counterbalance weights or lifting mechanisms can be provided.

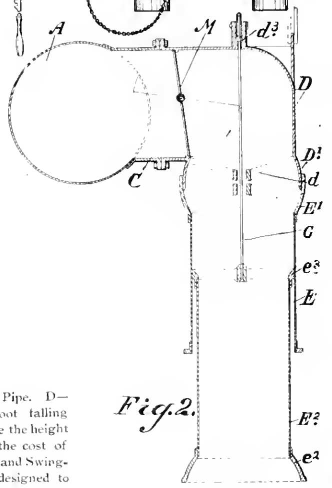


Fig. 2.

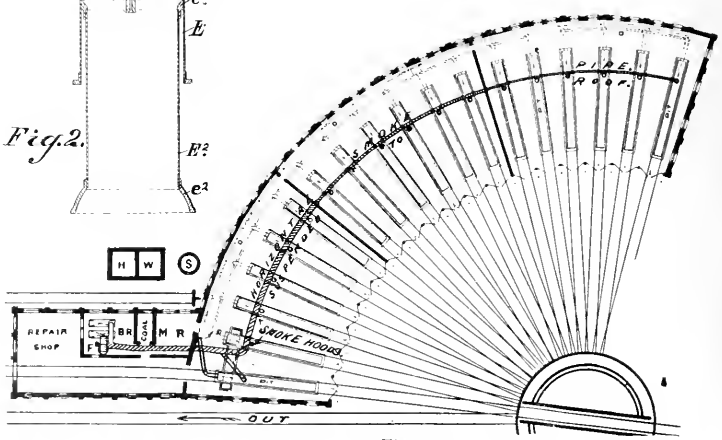


Figure 3.

B.R.—Boiler Room. F.—Induced Draft Fan for Boilers and Horizontal Main Smoke Pipe M.R.—Machinery Room, Fan Heater, Dynamos, Pumps, etc. D.D.—Hot Air Duct, Lorry Track above. H.W.—Hot Well. S.—Slushing Tank.

The main pipe somewhat resembles the breeching over a battery of boilers, but as the conditions are not so severe, the pipes may be of lighter material.

Railway corporations and municipalities will find this system removes all objections to the location of engine houses near residential property, where a factory chimney is permissible. The better draft in the fire-box of the locomotive will cause less smoke, and what is made can be delivered at a high elevation. There are many advantages to railway companies, cities, towns and employees in keeping the work of the employer and the homes of the employed near each other.

The advantages of this system are summed up as follows: It is independent of wind, weather, high buildings or hills; quick steaming and despatch of locomotives; no air or steam blowers required; freedom from storm water, condensation or back smoke; there being no pipes through roofs, no flashings are required; clean machinery, pure air, and improved conditions for employees, as well as for residents in the neighborhood.

SCIENCE AND ENGINEERING AWARDS AT TORONTO UNIVERSITY.

The following degrees and certificates are announced as the result of the recent examinations at Toronto University:

H. H. Angus, F. A. Gaby, N. R. Gibson, P. Gillespie, N. D. Wilson are eligible for admission to the degree of Bachelor of Applied Science, with honors.

E. W. M. Edward, C. J. Fensom, J. C. Gardiner, J. F. Hamilton, D. Mackintosh, A. H. McBride, J. A. McFarlane, I. H. Nevitt, E. W. Oliver, J. D. Pace, B. B. Patten, T. H. Plunkett, H. G. Smith, S. L. Trees are eligible for admission to the degree of Bachelor of Applied Science.

Prize in Civil Engineering for general proficiency in the third year, W. N. Moorhouse. The prize is a gift of Mr. T. Kennard Thomson, C.E., of New York, a graduate of '85.

S.P.S. Certificates.—Honors—H. H. Angus, F. A. Gaby, N. R. Gibson, P. Gillespie, A. H. McBride, H. G. Smith, N. D. Wilson.

Pass.—C. L. Coulson, W. M. Edwards, C. J. Fensom, J. C. Gardner, J. F. Hamilton, J. A. McFarlane, I. H. Nevitt, E. W. Oliver, J. D. Pace, B. B. Patton, T. H. Plunkett, S. L. Trees.

Department of Civil Engineering.—Honors—First Year—O. B. Bourne, A. L. Carruthers, M. J. Carroll, W. A. M. Cook, G. Clendinning, C. Johnston, A. G. Mackay, J. A. McKenzie, J. V. McNab, M. K. McQuarrie, J. M. Menzies, J. E. Parsons, H. L. Pringle, H. T. Routly, W. A. Scott, W. M. Stewart. Second Year.—W. Barber, N. L. Crosby, T. R. Loudon, W. J. Moore, W. M. Treadgold. Third Year.—T. F. Code, W. A. Cowan, S. R. Crerar, A. L. Ford, W. C. McFarlane, W. N. Moorhouse, J. D. Sheply, E. W. Walker, A. F. Wolls.

Department of Mining Engineering.—Honors—First Year—W. Huber, R. C. Purser, O. Rolfson. Second Year—W. A. Begg, C. S. Scott. Third Year—E. Wade.

Pass.—First Year—C. S. Acton, E. W. Banting, M. Bates, C. W. Bissett, E. J. Hassard, K. A. Mackenzie, C. J. Murphy, J. H. Ryckman, G. P. Stirrett. Second Year—W. C. Campbell, C. S. L. Hertzberg, D. W. McKenzie, W. N. Mc-

Lean, E. F. Pullen, C. L. Ramsey. Third Year—C. A. Chilver, C. J. Ingles, J. Parke, F. N. Rutherford.

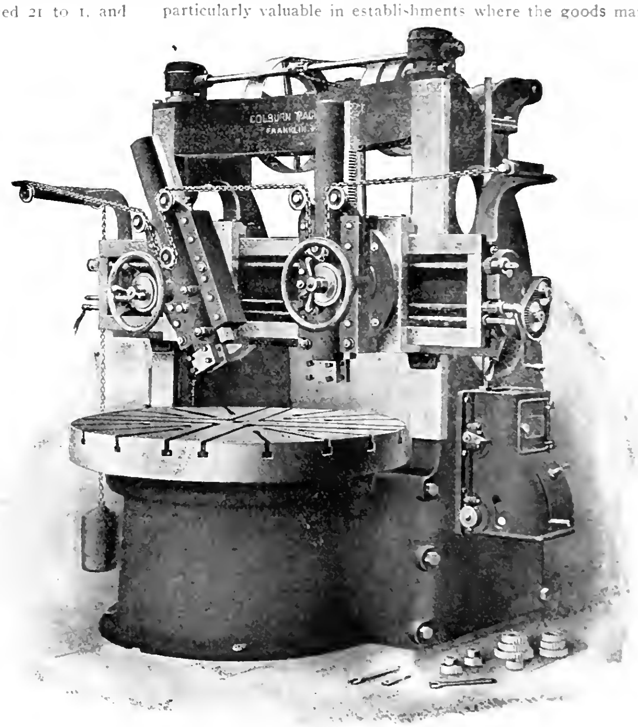
Mechanical, Electrical Engineering.—Honors.—First Year —W. L. Amos, J. C. Armer, F. Barber, W. C. Blackwood, C. A. Colhoun, R. S. Davis, C. B. Hamilton, A. L. Harkness, C N. Hookway, A. H. Hull, W. Maclachlan, D. G. McIlwraith, B. W. Marrs, W. K. Sanders, R. L. Sewell, C. L. Vickery, J. N. Wilson, E. M. Wood. Second Year—G. B. Aylesworth, G. G. Bell, W. R. Carson, F. W. Harrison, C. Kribs, C. E. Sisson, W. F. Stubbs, E. D. Tillson, W. E. Turner. Third Year—J. H. Alexander, J. H. Barrett, A. M. Campbell, C. P. McGibbon, A. E. Pickering, M. R. Riddell, R. S. Smart.

Department of Chemistry.—First Year—C. C. Forward.

The Cecil Rhodes scholarship has been awarded to E. R. Paterson, B.A., son of J. A. Paterson, K.C., Toronto.

FIFTY-THREE INCH VERTICAL BORING AND TURNING MILL.

The following is a description of a 53-in. vertical boring and turning mill placed on the market by the Colburn Machine Tool Co., of Franklin, Pa.: The capacity is full 53 inches in diameter, and will take 46 inches in height under the cross rail. The table is 50 inches in diameter, geared 21 to 1, and 105 to 1 with back gears in, and has 20 changes of speed. It is of massive construction and ample provision is made for securing any description of work, is driven by steel pinion on to cast iron spur gear with 105 teeth 2½ diametral pitch, and powerfully geared from high-speed drive. The table speeds are correctly graded in geometrical progression. The spindle is of cast iron with large angular babbitted bearing at the top and straight vertical bearing in the centre. Bearings running at high speed, or subjected to heavy wear, are bushed with bronze. The heads are entirely independent in their movements, both as to direction and amount of feed, can be set to any angle and carry tool bars that have a movement of 25 inches. Either head can be brought to the centre for boring, and centre stop determines its correct position. The cross rail is 7 feet long, extra heavy, and is raised and lowered by power. The feeds, both vertical and horizontal, are duplicated on the right and left hand side of machine, are positive, have 10 changes ranging from 1-32 to ¾ of an inch horizontally, and from 1-64 to ⅜ of an inch in vertical and angular directions, and are in correct geometrical progression. The screw cutting attachment, when ordered, is furnished for right hand side unless otherwise specified; but can be fitted to either side as required. It is arranged to cut from 4 to 13 threads per inch, including 11½ for pipe thread. All feed and change gears are clearly indicated on an index plate in plain view, and are readily adjusted for the required changes. The lubrication of machine has received careful attention, and proper provision for convenient and ample oiling of all sliding surfaces and running bearings has been provided. Belt drive: When machine is supplied as regularly equipped with belt drive, it has five step cone for 3-inch belt. The full range of speeds are obtained by shipping countershaft speed between each successive step of cone, giving ten changes, which number is doubled by throwing in back gears, avoiding the confusion and complication embodied in some makes now on the market, and subsequent neglect in taking advantage of the full range in grade of speeds and feeds. The floor space outside of all projections is 9 feet 5 inches by 7 feet 6 inches. [illegible] height from floor to centre of cone pulley is 94 inches. Diameter of large step 20 [illegible]. Diameter of plain pulley 24 inches. Extreme height [illegible] feet 10 inches. The cone pulleys do not overhang but are placed between the housings, and the shafts on which they run are supported on both ends. Two countershafts are regularly furnished, one mounted on the housings of the machine, carrying the upper five-step cone pulley and one 24-inch pulley for 4-inch belt. The other countershaft has double tight and loose pulleys, 20 inches in diameter, for two open 4-inch belts; also one 24-inch driving pulley for 4-inch belt. The speeds of this countershaft should be 425 and 499 revolutions per minute. The net weight of 53-inch mill is about 17,000 pounds.



Fifty-three Inch Vertical Boring and Turning Mill

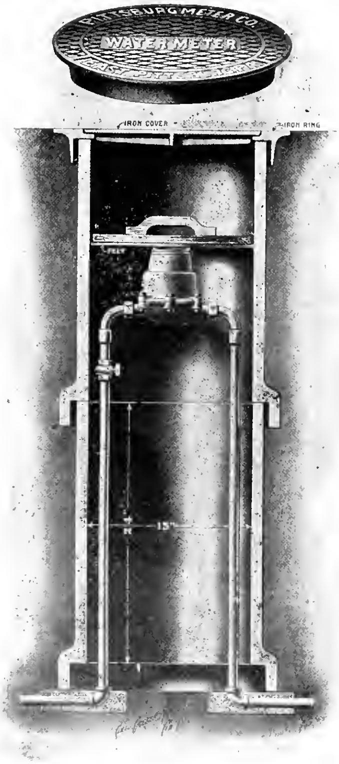
WATER SOFTENING.

"Worth Knowing" is the title of a book issued by the Keystone Chemical Manufacturing Co., of Camden, N.J., setting forth the claims of Keystone tri-sodium phosphate. This Keystone tri-sodium phosphate ($Na_3 Po_4$) is a white crystalline substance resembling table salt, is very soluble in water, non-corrosive in action, and, being non-volatile, will not vaporize and pass off with the steam. This makes it particularly valuable in establishments where the goods manufactured are of such a delicate nature as to be affected by coming in contact with the steam, as in lard refineries, breweries, ice manufacturing plants, etc. It is the only commercial chemical that will, with or without heat, immediately change the hardenable carbonates of lime, magnesia and other incrusting minerals into unhardenable phosphates, and neutralize the carbonic and sulphuric acid released by decomposition, producing a clear, soft, harmless water. From the fact that water hardness and boiler incrustation result from the presence of these minerals, the great value of this chemical is seen. The boiler compounds that are composed mainly of tannic acid and caustic soda, mixed in different proportions, are replaced with a scientific chemical containing neither of these ingredients, and one having a positive action that is both chemically and mechanically correct.

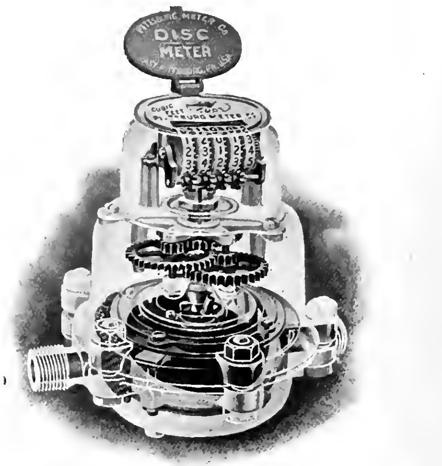
Analysis of scale taken from boilers in the affected districts shows that incrustations are chiefly composed of carbonate of lime, carbonate of magnesia and sulphate of lime. The carbonates are insoluble in pure water, and owe their presence in springs and rivers to free carbonic acid, which forms with them soluble bicarbonates. Boiling such water expels carbonic acid, and the carbonates of lime and magnesia separate and deposit in the form of insoluble powders, which, in combination with organic matter, bake into scale. The action of Keystone tri-sodium phosphate upon these insoluble carbonates is to convert them into phosphates of lime and phosphate of magnesia, substances resembling snowflakes in appearance. It also neutralizes the carbonic acid released from the carbonates of lime and magnesia, preventing all corrosive action. The manufacturers have such unbounded faith in the goods they manufacture that they are not only willing to send their book, "Worth Knowing," to anyone having trouble with scale in their boilers, but are willing to make analysis of the feed water and ship a sufficient quantity of the chemical for thorough trial, free of charge, that its value may be demonstrated.

SETTING WATER METERS.

Where water meters are to be set outside, the method illustrated herewith may be employed to good advantage, as this mode of installing meters is inexpensive and has been adopted by a large number of Water Departments with satis-



factory results. The meter box, as shown, consists of two sections of 15 inch vitrified sewer pipe, resting on a brick foundation, and covered with a strong, corrugated cast-iron ring and cover. In localities subject to hard frost the wooden lid shown may also be installed. The bottom of this lid is covered with felt, and rests lightly on the top of the meter, thus forming an air space between the meter and the outer cover and retaining the heat which arises from the warm earth below the frost line, thereby preventing the meter from freezing. The depth of this box may be increased by the addition of another length of sewer pipe, or by adding to the height of the foundation underneath; the foundation can be built either of concrete or brick laid dry, depending



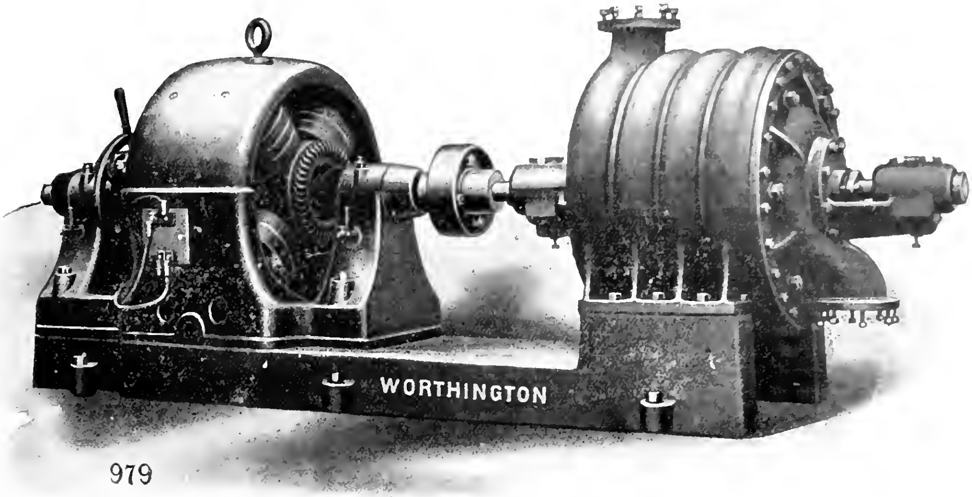
upon the character of the soil; or, in fact, any other changes desired may be made to meet local conditions. The meter box, as illustrated, is supplied by the Pittsburg Meter Co., of Pittsburg, Pa., and is capable of accommodating either a ⅝ inch or a ¾ inch water meter. The company supplies the iron rings and covers, as illustrated. A ring and cover weigh about 65 lbs. The other materials required for the construction of this type of meter box are easily obtained anywhere.

WORTHINGTON CENTRIFUGAL PUMPS.

Few problems in the field of hydraulics present more interesting possibilities and at the same time have been so universally neglected as centrifugal pumping. The centrifugal pump is the converse of the turbine water-wheel. Its development has been analogous to that of the steam turbine in that both were pioneers in their respective fields, and both were abandoned in favor of reciprocating machines before having been thoroughly exploited, the pump because the principles of its action were not clearly understood, and the steam turbine because of mechanical difficulties in construction.

The earliest history of the centrifugal pump cannot be traced, but it is known that centrifugal machines for lifting liquids were in use during the latter part of the seventeenth century. About 1703, Denis Papin, the famous French engineer, designed his Hessian Suck, a form of centrifugal pump embodying nearly all of the essential features of the present day machine. Drawings of this pump are in existence which show that Papin was not only a designer of no mean ability, but that he had a good comprehension of the principles with which he was dealing. After Papin there seems to have been no further development of his ideas until 1818, when the earliest prototype of the present form of centrifugal was brought out in Massachusetts, and has since been known as the Massachusetts pump. This pump was of the type herein designated volute, and was provided with double suction openings and an open impeller. It was re-invented by Andrews and others in 1846 and was shortly afterwards introduced into England by Mr. John Gwynne.

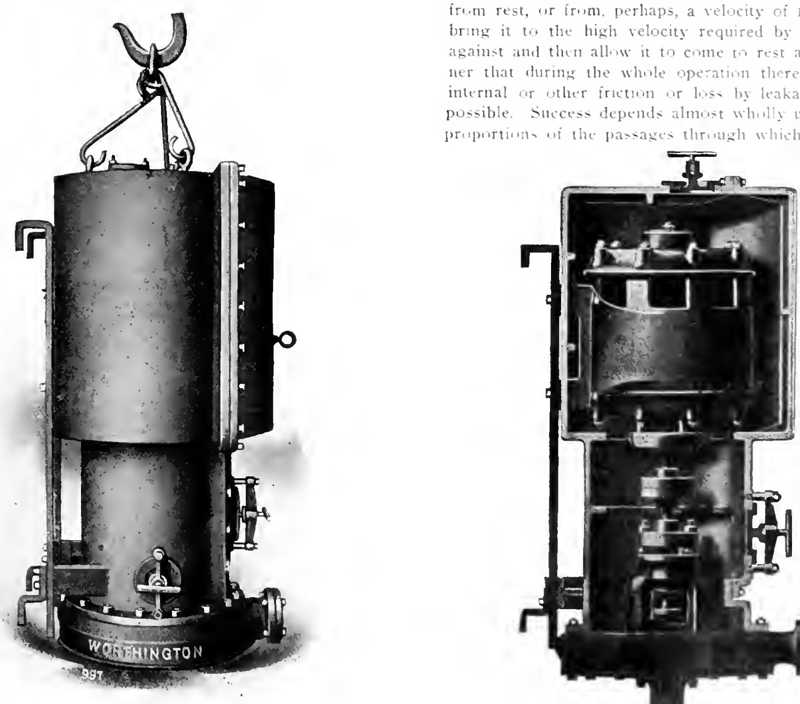
The commercial history of the centrifugal pump dates from the year 1849, when Appold exhibited a model at the meeting of the British Association at Birmingham. During the next two years he so improved on his first model that his pump became one of the chief features at the Exhibition in



Five-Inch, Four-Stage Turbine.

Used as a station pump in a gold and silver mine. Capacity, 500 gallons per minute against 520 feet head.

London, in 1851. The interest aroused by Appold's pump was productive of much experimentation and discussion, which resulted in improving the pump until it assumed the form that it has maintained up to the last two or three years. Many attempts were made at high-head work, but without success.



Three-Inch, Turbine Sinking Pump.

The direct-connected motor is enclosed in a cast-iron housing.

From the crude and inefficient low-lift pump this company has developed a scientifically designed, high-lift centrifugal, which has found application within the field hitherto occupied by displacement pumps exclusively. While 50 feet head was formerly considered the maximum for efficient operation, 2,000 feet is now practicable, and the efficiency has been placed on a par with that of displacement pumps. There has also been plenty of room for improvement in low-head pumps and these have not been neglected while perfecting the high-head pump.

The problem of the centrifugal pump designer is to so proportion the parts of his pump that it will pick up the water from rest, or from, perhaps, a velocity of 10 feet per second, bring it to the high velocity required by the head pumped against and then allow it to come to rest again in such manner that during the whole operation there shall be as little internal or other friction or loss by leakage or slippage as possible. Success depends almost wholly upon the form and proportions of the passages through which the water enters the impeller chamber, the shape of the impeller vanes and the design of the chamber into which the water is delivered from the vanes.

The early centrifugal pumps were made with straight, flat vanes, which discharged into a chamber of more or less conventional form. The result was excessive internal friction,

All velocity consumed by friction and eddy currents in the water is so much lost work and is not effective in producing hydraulic head. The great improvements which have been made in the characteristics of centrifugal pumps have followed from careful, scientific design in proportioning severally the various parts of the pump chamber, the impeller and the diffusion vanes between the periphery of the impeller and the case. It is possible by properly proportioning the several parts to build a pump having almost any desired characteristics and fitted for any special requirements of service.

The Worthington centrifugal pumps show efficiencies nearly always in excess of those of other types of power-driven pumps used in the same services. Heretofore, the efficiency curves of centrifugal pumps have always reached maximum values at points which the builders (endeavoring to adapt one design to all services) seem to have been unable to control. However, by intelligent, specialized design, this maximum point can be made to occur at any desired head. This is accomplished by modifying the internal proportions of the pump without in any way changing the general mechanical features.

The Worthington centrifugal pumps are divided into three classes, viz.: Conoidal, volute and turbine. The conoidal centrifugals are designed especially for low lifts and large deliveries and are adapted to irrigation work, the handling of sewage and similar purposes. They are comparatively inexpensive, and operate at high rotative speeds, making possible direct connection to electric motors. For heads up to 30 feet they are unexcelled in the pumping field.

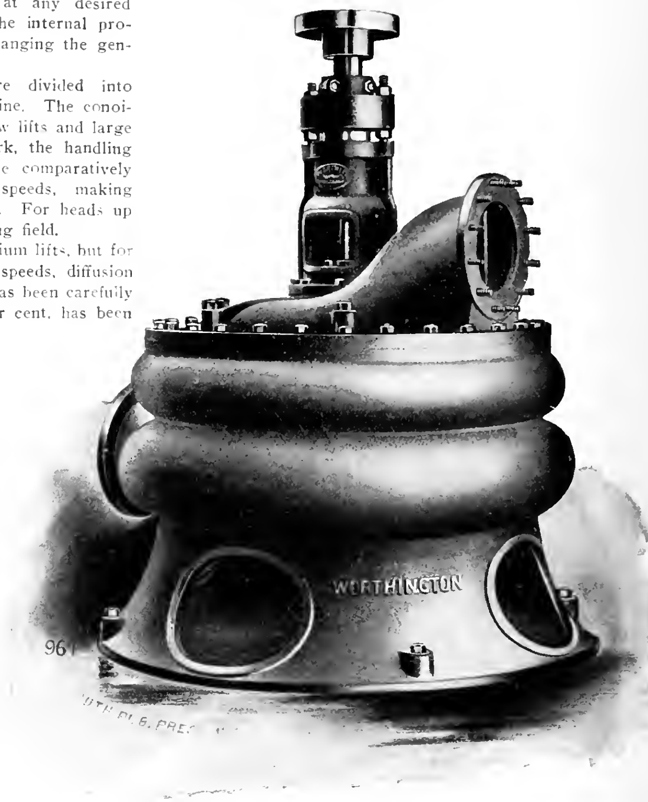
The volute centrifugals are built for medium lifts, but for all capacities. Since they run at moderate speeds, diffusion vanes are not needed, but the volute casing has been carefully designed to obtain high efficiency, and 86 per cent. has been shown under test. These pumps are recommended for heads up to 70 feet, although they will safely withstand 150 feet.

The turbine pump is suited to very high lifts, even exceeding 2,000 feet.

The Worthington turbine pump has been developed by a long series of experiments conducted by able engineers under the direction of the foremost specialist in this field. The diffusion vanes, which form the distinguishng feature, take the place of the usual whirlpool chamber in other forms of centrifugal pumps and assist in bringing the water to rest without internal commotion or shock. They correspond in function to the guide vanes of turbine water-wheels. One of the difficulties presented by high-lift centrifugal pumps has been the great peripheral speed required when only a single impeller is employed. This has been overcome in the Worthington multi-stage turbine pump by mounting a number of discs or impellers, each operating in a separate chamber, upon a single shaft and passing the water through the impeller chambers in succession. The lift can thus be multiplied three, four or five times, while the number of revolutions is kept within such bounds that it is possible to connect the pump directly to a steam engine or an electric motor. It has been demonstrated by experiment that on the same work and within reasonable limits, multi-stage centrifugals are more efficient than single-stage pumps, the increased efficiency being due to a decrease in the frictional losses coincident with the reduced peripheral speed of the impeller.

Particular attention has been devoted to the mechanical details in order to produce a machine that would withstand the most severe service for long periods of time without renewals or repairs. The bearings, of liberal proportions, are supplied with ring oilers, and are lined with the best quality of babbitt, hammered in, reamed true, and scraped to a perfect fit. In all except the very small sizes these bearings have been entirely separated from the pump casing, an improved form of construction effectually eliminating all possibility of foreign matter working into the bearings when the pump is handling water containing silt or sand. This construction further makes it possible to renew the bearings without entirely dismantling the pump, and will meet with the approval of all engineers familiar with centrifugal or rotary pumps. The shafts are of machine steel. They are mathematically accurate and straight and are perfectly polished.

It is frequently found necessary to locate a centrifugal pump in a pitch below the floor level, in order to get within suction distance of the water supply. In cases of this kind the vertical centrifugal has been extensively used and has proved most satisfactory. The pumps can be either belted or connected directly to vertical motors. The latter method makes an ideal pumping plant, as the motor can be located above ground, where it is free from all moisture, and can receive proper care. The design of the pump is such that it requires very little attention, and it is necessary for the attendant to go down into the pit only at long intervals. A number



Twelve-inch, Two-stage, Vertical Turbine.
Designed for direct connection to a vertical-shaft motor. For general water service in a large steel plant. Capacity, 5,000,000 gallons per day against 140 feet head.

of these pumps are being used at blast furnaces and steel mills for general water service. They are also widely used in irrigation for pumping from wells in which the water level fluctuates greatly, often submerging the pump and rendering the use of horizontal belted or motor-driven pumps inadmissible.

In starting centrifugal pumps massive foundations are not necessary, but the pump should be so placed that perfect alignment is assured. The suction line must be free from air leaks, and, if more than twenty feet in length, it should be larger than the pump suction to avoid undue friction. The discharge line must be of sufficient size to remove the water without excessive friction loss. A gate valve should be located in the discharge near the pump. Before starting the pump, it is necessary to fill the casing and suction line with the fluid to be pumped, as machines of this type will not create a vacuum of any moment without first being primed.

The accompanying illustrations show several types of Worthington centrifugal pumps. These pumps are manufactured by the John McDougall Caledonian Iron Works Co., Limited, Montreal.

GRAIN PRESSURE IN DEEP BINS.*

By J. A. Jamieson, C.E., Montreal.

(Continued from May issue.)

Grain Pressure Test, No. 1A.

Wheat.—Corrugated Steel Bin.—Bottom Pressure Test.
Size of Bin 12" x 12" x 6' 6" high.
Diaphragm on bottom, size 12" x 12" = 144 sq. inches.
Wheat 50 lbs. per cu. ft., equal to 62.2 lbs. per bushel.

Grain weighed into bin.	Height of grain column.	Equival'nt fluid Pressure	Pressure grain on diaphra'm	Grain carried on bottom. Weight	% of total weight of grain.	Grain carried on bin-side. Weight.	% of total weight of grain.
lbs.	in.	in. water	in. water	lbs.		lbs.	
25	6	4.81	3 1-2	18.184	72.7	6.816	27.3
50	12	9.62	5 1-2	28.575	57.1	21.425	42.9
75	18	14.43	6 5-8	34.420	45.9	40.580	54.1
100	24	19.24	7 1-2	38.966	38.9	61.034	61.1
125	30	24.05	7 7-8	40 914	32 7	84 086	67.3
150	36	28.86	8 1-16	41.888	27.8	108.112	72.2
175	42	33.67	8 1-4	42.863	24.5	132.137	75.5
200	48	38.48	8 7-16	43.837	21.9	156.163	78.1
225	54	43.29	8 1-2	44.161	19.6	181.839	80.4
250	60	48.10	8 1-2	44 161	17 6	205.839	82.4
275	66	52.81	8 9-16	44.486	16.1	230.514	83.5
300	72	57.62	8 3-4	45.460	15.1	254.540	84.9
325	78	62.53	8 3-4	45.460	13.9	279.540	86.1

Effect of 50 lbs. of weights placed on top of grain column:—

682	[1]163,68	131,27	9⅜	48,708	7.1	633,292	92.9

Increase of pressure on bottom by placing weights on top of grain column in bin:—

Weights. lbs.	Increases gauge reading From	To	Increases in Inches.	lbs.
50	8¾	9⅜	⅝	3,247
100	9⅜	10	⅝	3,247
150	10	10⅝	⅝	3,247
Total increase with 30 lbs.			1⅞	9,741

When weights were removed gauge returned to 8¾".

Note.—By sharply tapping sides of bin, grain settled 2¼" from top, and gave a maximum gauge of 10½" of water, equal to a load on bottom of 54.553 lbs., or 16.78 per cent. of total weight of grain in bin.

By raising bin by means of screws at the corners, the gauge receded to 7 inches.

1A grain column weighing 325 lbs. exerts a pressure of 45.46 lbs. on the bottom. 50 lbs. therefore are equal to

$$\text{a grain column weighing } \frac{326 \times 50 \text{ lbs.}}{44.56} \text{ or } 357 \text{ lbs.}$$

This added to the 325 lbs. already in the bin equals 682 lbs.

The author may state here that while vibration or shock will slightly increase both the vertical and lateral pressure, as the lateral pressure increases the total friction on the wall will correspondingly increase and therefore there cannot be found any good reason for assuming any material increase of pressure due to shocks. Again, by slightly raising the bin with screws inserted between the frame of the diaphragm and the bottom of the bin walls, the pressure on the bottom could be very materially decreased. This decrease allowing the water in the gauge to recede from the maximum of 10½ inches to 7 inches, clearly shows that the greater the pressure on the sides the greater the load carried by the walls. Again, by placing Standard weights of 50 lbs. each on top of the grain, the pressure on the bottom could be only slightly increased by each weight applied, while the pressure on the bottom again decreased as the weights were removed. This experiment was repeated a number of times, in one case 400 lbs. of weights being applied, with practically the same results in every case; indicating clearly that the increased pressure on the bottom by the application of weights on the top of the grain, was due to a slight vertical compression of the bin walls, or the elasticity of the grain. On the bin being again lowered to its original position, while no increase of lateral pressure was shown by the side diaphragm, there was a very large increase of pressure on the bottom diaphragm, sufficient to cause the water to flow out of the top of the 4 ft. gauge glass tube, which was not therefore long enough to record the pressure; in fact, the total weight of the grain was then resting on the bottom diaphragm, and in addition the grain was acting as a column to support the weight of the bin itself.

Very careful tests were also made to ascertain the pressure due to grain in motion, or when the grain was being drawn out of the bin. To obtain the bottom pressure, the grain was drawn from an opening in the side of the bin close to the bottom. There was found to be a decrease of pressure on the bottom when the gate was opened and this decrease was maintained until the bin was about half emptied, then it became approximately the same as when the bin was being filled. Near the bottom the pressures showed an increase over the curve obtained when filling the bin; this, however, was entirely due to the necessity of drawing the grain from the one side of the bin, as when nearly emptied, the remaining grain was all on one side of the bin, and therefore nearly all resting on the bottom.

When the grain was being drawn from the opening at the side of the bin, it was found that there was considerable difference in lateral pressure on the different sides. On the side directly opposite to the opening there was a large increase of pressure, and on the same side as the opening the pressure decreased to less than half, when the 3" x 12" rectangular diaphragm was being used, and when the 2" square diaphragm was placed directly over and a short distance above the opening, there proved to be practically no lateral pressure at this point.

When the bin is being filled or when the grain is being drawn from the opening of a square or cylindrical bin through an opening exactly in the centre, a line drawn vertically through the centre of the bin is the centre of pressure, and the lateral pressure per square inch is equal on all sides of the bin. If, however, the grain should be drawn from an opening in the side of the bin, or in the bottom close to the side, then, owing to the moving column of grain being over the opening, the centre of pressure is changed, and the lateral pressure is considerably increased on the side opposite to the opening and decreased on the side over the opening, thus throwing very uneven strains into the bin walls. In a square bin, this will simply throw the increased pressure on the far wall, but in a cylindrical bin this must have a very injurious effect, unless the walls should be of very rigid construction. In a steel tank, the walls of which are very thin and have practically no rigidity, this uneven pressure tends to throw the tank considerably out of round, while the decreased pressure on the side over the opening makes this part of the tank shell very unstable as a column to carry the vertical load, with the result that steel tanks often buckle inward at varying distances above the opening. This conclusively shows that in all bins and especially those of cylindrical shape, to avoid these excessive strains, the grain should always be drawn from an opening in the centre of the bin. This fact has an important bearing on the weaknesses developed by different tank constructions and will be referred to in connection with the "Problem of Grain Bin Design."

To properly ascertain the lateral pressure when the grain was being drawn from an opening in the centre (which is the usual manner in small bins) the bin was provided with a hopper bottom, with the gate opening directly in the centre, the diaphragm being placed on the side as before. The grain was then drawn out and weighed, the gauge carefully observed, readings recorded at the end of each draft, or when the gate was closed, and to ensure getting all fluctuations of pressure, two or three intermediate readings were taken while the grain was in motion. Several similar tests were made with varying sizes of gate openings and grain running out at speeds varying from 50 lbs. to 120 lbs. per minute, and the increase of lateral pressure due to grain in motion over grain at rest, or when the bin was being filled, was found to vary from

*From a paper read before the Canadian Society of Civil Engineers.

5 to 9.3 per cent., the latter being for the highest speed, which is, however, relatively much greater than would be attained in practice in full-sized bins.

Tests were also made by pouring grain in at the top at varying speeds, while it was being drawn out at the bottom, but this was found to have no appreciable effect until the bin was nearly emptied, and the pressure had considerably decreased. By pouring grain in at a higher speed than it was drawn out, we could again raise the pressure, but in no case did this raise the pressure beyond the maximum of 9.3 per cent. over that obtained while filling the bin.

If the grain is drawn from the centre of the bin, it may be safely stated that the increase of pressure due to the grain in motion, over grain at rest, or when the bin is being filled, will not exceed 10 per cent., and the increase will be considerably less than this when the ratio of the area of the gate opening to the area of the bin is 1.150, which is approximately the usual practice in standard sized bins.

That no larger increase of pressure actually takes place due to grain in motion when the grain is being drawn from the centre of the bin bottom is, the author believes, fully shown by his tests in the model and full size bins. With an experience of twenty years in grain elevators, he has never known any weakness develop in any part of a bin or other construction, with one exception, when a bin bottom failed because the operating staff disregarded instructions in filling the bin for the first time, causing the full settlement to take place at once.

After speaking of various tests made in the model bins, details of which he gives in his paper, the author refers to tests made in the bins 6 inches square and 6 inch diameter and 6 feet 6 inches deep, with a view to determining the difference in pressure due to difference in breadth or diameter. It was found that in each case the pressure per square inch was approximately twice as great in the 12 inch bin as in the 6 inch. Thus, if four 6-inch bins were filled with 325 lbs. of grain, the combined load resting on the bottom of the four 6-inch bins would only be one-half as much as in one 12-inch bin. A test was also made by using a stout canvas bag or cylinder 12-inch diameter, 6 feet 6 inches deep, provided with metal rings at both ends, one ring attached to the metal frame of the 12-inch circular diaphragm and a 6-inch gauge glass was used. This formed a cylindrical bin with wall incapable of supporting any vertical load. The bag was extended to full height and the wheat poured in at the top. When the bag was full, it was found that the height of water in the gauge glass multiplied by the area of the diaphragm gave 1½ lbs. more than the total weight of grain, showing that the grain column was supporting a part of the weight of the bag, which weighed 3¼ lbs., and incidentally proving the correctness of the hydraulic diaphragm and water column as an accurate weighing machine. A test was also made in the 12-inch diameter cylindrical bin, using sand instead of grain. The sand was thoroughly dry, clean and of good building quality. Angle of repose 34°, weight 100 lbs. per cu. ft. 537½ lbs. were put into the bin, and it was found that 99.211 lbs. or 19.45 per cent. was resting on the bottom, and 438.289 lbs. or 81.55 per cent. carried by the sides. (It is interesting to note that both sand and wheat gave approximately the same percentage of total weight resting on the bin bottom or diaphragm. The wheat weighed 50 lbs. per cubic foot and gave 18.20 per cent. on the bottom and 81.71 per cent. carried on the sides).

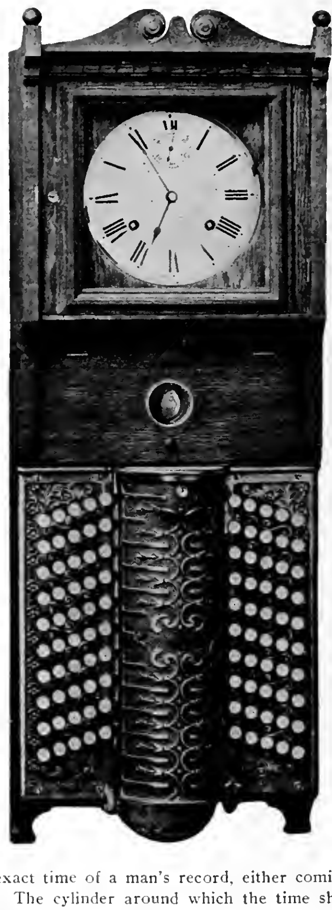
By sharply tapping the cylinder on both sides with the hands, the sand settled 3 inches, increasing the load on the bottom to 120.272 lbs., or 22.37 per cent. of the total weight of sand in the bin.

In conducting the tests, the co-efficient of friction between the grain and the bin walls was readily obtained in the following manner: Having found the total grain weight resting on the bottom of the bin, we deduct this bottom weight from the total weight of the grain in the bin. This gives the weight supported by the walls, and by dividing this weight into the total side pressure, we get the co-efficient of friction. The total side pressure was obtained by multiplying the pressure per square inch for each section of the bin, by the area of the walls, and the sum of the pressures per section give the total pressure on the bin walls.

(To be continued.)

TIME RECORDER FOR FACTORIES.

A new time-recording machine having several points of merit, has been put on the Canadian market by Munderloh & Co., Montreal. In this device the time sheet is fastened to a cylinder, and when an employee presses the button it rings a bell and records the exact time on the sheet by means of a steel pin which makes an indelible perforation in the time sheet within the recorder. The cylinder revolves slowly by power transmitted from, and in exact unison with, the clock. The time sheet is legible and may be rapidly checked. The sheet is ruled horizontally into 30, 50 or 100 spaces, according to the number of employees for which the machine is designed, and it is then ruled perpendicularly into hour, half-hour, quarter, and five-minute spaces, each plainly distinguished by its particular color. A glance at the time sheet



tells the exact time of a man's record, either coming to work or going. The cylinder around which the time sheet is fastened is of hard rubber, with nickel-plated mountings, and is very light. Horizontal grooves are turned in its circumference which allow the pin points to pass through the sheet, making clean, round perforations. The cylinder rests on a pointed steel bearing and is revolved by a worm and gear device at the top connected with the clock movement. The power required to turn it is so slight as not to be perceptible in the action of the clock movement.

HAMILTON AS AN ELECTRICAL POWER CITY.

Hamilton is known as the Birmingham of Canada, but it may well be said to be the Birmingham and Manchester combined, for, not speaking of other branches of textiles, it has more cotton mills than any city in Canada except Montreal, and is one of the chief centres of clothing manufacture. It is the largest centre of stove foundry business in the Dominion, and it has an important and constantly growing aggregation of miscellaneous manufactures in iron, brass and other metal work.

Hamilton has successfully solved several problems of municipal engineering such as sewage disposal and street paving, and it has also taken greater advantage of the development of electrical science than any other city in Canada in proportion to its population. Much of its recent increase in population and industrial progress is due to the early faith of its citizens in electricity: and it should be remembered in this connection that as early as 1881 an exhibition of arc lighting was here given in Dundurn Park on the occasion of the visit of the Marquis of Lorne. This is, perhaps, the first demonstration of arc lighting in Canada, the mechanism being constructed by Thomas L. Willson, the pioneer of acetylene lighting, and the discoverer of the commercial method of producing calcium carbide. The selection of Hamilton, (closely related as it is to the great electrical works at DeCew Falls and Niagara Falls), as the place of meeting for the Canadian Electrical Association this year is very natural, and those interested in the progress of electricity will be much impressed by what they see in that city and the Niagara Peninsula, through which they will make an excursion.

Elsewhere in this issue will be found a programme of the convention, a sketch of the extensions to the Cataract Power, Light and Traction Co.'s works, the Canadian Westinghouse Co.'s new works at Hamilton, and a brief review of the progress of work on the three Niagara Falls.

VIEW OF HAMILTON FROM THE MOUNTAIN.

A United States [illegible] wished to desert [illegible] so disorganized the [illegible] the station, so that [illegible] before they could be [illegible]

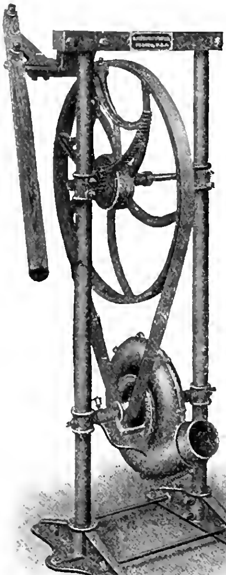
* * *

Supplementary letters patent have been issued in New Brunswick, giving directions to the People's Light and Power Co., so as not to interfere with the New Brunswick Telephone Co., in the erection of lines in Fredericton, N.B.

Prof. Fessenden, whose wireless telegraph [illegible] the London Times is using to obtain its war news in the Far East, is a native of Hamilton, Ont., where his mother, Mrs. C. Fessenden, who has been the promoter of Empire Day observances in Canadian schools, lives. He is a nephew of Judge Trenholme, of Montreal.

THE STURTEVANT IMPROVED HAND BLOWER.

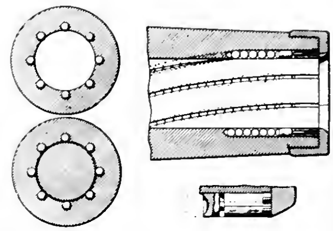
In these modern times men are always seeking devices by which they may accomplish the greatest results with the least exertion. To this fact, doubtless more than any other, was due the rapid introduction of the hand blower as a substitute for the old-time bellows. During the years which have elapsed since this change the B. F. Sturtevant Co., of Boston, Mass., pioneers in the manufacture of blowers, have been perfecting their design and construction until their hand blower, known as Style A, has shaped itself into a new design known as Style B, as herewith illustrated. These hand blowers have been extensively introduced in connection with new forges of all kinds, and have likewise been applied to old style brick and iron forges as simple, efficient and economical substitutes for the bellows. Not only are they adapted to forge blowing, but can readily be applied as portable ventilating apparatus. They are simple in design, strong, compact, economical in operation and portable. The lower is adjustable on the shaft, and its outlet may thus be set to discharge in any direction, and readily connected to the forge tuyere by means of galvanized iron piping. The blower is of cast-iron, strongly constructed; has a steel shaft running in babbitted boxes, and a fan wheel of galvanized steel solidly riveted to a composition hub with extending arms. The frame is well braced, and is so arranged that the slackness of the belt driving the blower may be taken up by lowering the blower shaft, which is supported by collars sliding on the frame. The blower may be screwed to the floor by holes in the feet. These hand blowers are made in two sizes. The total length on the floor of style B is 18 inches, while the total height of the frame, not including the handle, is 48 inches. The driving wheel is 24 inches in diameter, the blower outlet is $3\frac{1}{2}$ inches in diameter, and the complete outfit weighs but 135 pounds. Style B-2 is of slightly larger dimensions, and has proportionately greater capacity for delivering air. The driving wheel is 24 inches in diameter, the blower outlet is $4\frac{3}{4}$ in. in diameter, and the complete outfit weighs 155 pounds.



BALL-BEARING ORDNANCE.

A unique application of the ball-bearing principle in the reduction of friction is seen in the rifled gun, invented by Capt. O. C. Cullen, a United States officer, who commanded a battery in the Spanish-American war. The new principle is the inserting of balls in the grooves of the rifle. It is stated that this is the first radical improvement in rifling since 1852, the ingenuity of ordnance makers being devoted towards developing breech mechanisms and other details of ordnance construction to the neglect of the barrel.

The advantages of the weapon may be summed up as follows: The ball-bearing grooves give a rotary motion to a smooth projectile, something that has been long sought for but never before attained. The smooth projectile is much cheaper, as no copper band is required, and the energy that is consumed in forcing a banded projectile through the grooves of an ordinary rifled gun is added to the force behind the projectile, thus increasing its velocity, penetration and range. It is claimed that the strain on the wall of the gun is reduced seventy-five per cent., except over the breech, where the initial explosion occurs, so that the weight of the gun may be considerably reduced, thus cheapening cost and facilitating ease of handling. The life of the gun is prolonged indefinitely. When one set of balls is worn out another can be substituted. The average life of one set of balls is 3,000 rounds. Calculus shows that it is possible to renew the balls four times before metal fatigue limit of the walls of the grooves is reached. The velocity and penetration of the projectile is increased. In a test with the Driggs, Hotchkiss and Maxim guns, which are said to be the best types of modern rifled ordnance, it is claimed that the Cullen gun showed its great superiority. The average velocity of the latter at the muzzle was 3,200 feet per second, as against 1,800 for the Driggs and Hotchkiss and 2,000 for the Maxim. All four were fired at a plate of nickel steel 20 feet square and $1\frac{3}{8}$ inches thick at 3,000 yards range. The projectile from the Cullen gun penetrated the plate, ricochetted and was picked up 1,626 yards beyond, embedded 18 inches in the dirt. The Driggs and Hotchkiss failed to penetrate, and glanced into the earth in front. The Maxim stuck in the plate with the point projecting $\frac{5}{8}$ of an inch through it. The test was made with a two-pounder, the conditions being precisely the same, except that the ball-bearing gun used a smooth projectile and all the others banded projectiles.



The initial power of the charge not being required to force the soft metal band of the projectile through friction grooves, the length of the barrel may be shortened from 75 to 85 calibres to 45 to 55 calibres, or even less. Friction being reduced, the gun does not heat up to such an extent. The absence of the ring of soft metal around the projectile will permit the use of nose fuses, which are more reliable than base fuses. The smallness of the recoil will permit of lighter gun carriages being used. The band on the projectile being dispensed with, the flight of the smooth projectile will not be interfered with by jagged excrescences formed on the band in its passage through the grooves, thus promoting accuracy.

The accompanying diagrams will explain the principle of the invention, which can be applied to all classes of firearms—cannon, rifles and revolvers. The smaller of the cuts shows a glycerine cushion at the muzzle, against which the balls rest.

A number of Governments have adopted the ball-bearing gun, and Capt. Cullen is now in Canada bringing it under the notice of the militia authorities. His works are at Waterlick Station, Virginia.

The new bridge over the Zambesi, at Victoria Falls, Africa, will cross the river 420 ft. above the water, being the highest bridge in the world. That distinction now rests with a bridge over Stony Creek, on the C.P.R., in the Rockies.

RAILWAY NOTES.

Mr. Sloan, of Chicago, has been granted a franchise for an electric railway at Stratford.

The Nova Scotia Steel and Coal Company have purchased two new locomotives for work on their road in Cape Breton. They are named John F. Stairs and Senator McGregor.

Two monster freight sheds are to be built by the C.P.R. at Winnipeg, one 1,224 feet, the other 608 feet in length. New roundhouses are being built at Winnipeg. Brandon, Moosejaw, Swift Current and Ignace.

A complaint having been made that alien engineers are being employed on the Grand Trunk Pacific surveys, Judge Winchester, of Toronto, has been commissioned by the Dominion Government to enquire, and has entered on an investigation.

The Tilsonburg, Lake Erie and Pacific Railway has a project on hand for an extension north from Ingersoll. Whether it should go north to Stratford by Embro or through Woodstock to Berlin has not been decided. It is possible the C.P.R. may obtain control.

Building operations in the burnt district in Toronto are being retarded by the application of the Grand Trunk for power to expropriate some of the property south of Front Street for new tracks. It is possible the Union Station may be greatly enlarged, or perhaps an entirely new station built.

The C.P.R. will spend about $30,000,000 this season. Some $10,000,000 will be required for North-West terminals, hotels, stations and the like, and the improvements at Montreal, Winnipeg, and Vancouver, the building of five hundred miles of new road in the North-West, the carrying out of the irrigation scheme, and the addition to equipment will take up the rest.

A bill before Parliament empowers the Guelph Junction Railway, which is owned by the city of Guelph, to extend its line westward to Goderich, with branches to St. Mary's and Clinton, via Stratford. The bill gives the owners authority to enter into an agreement either with the C.P.R. or the Guelph and Goderich Railway for the construction and sale of the proposed Goderich extension.

The first eight of twenty-five of a new type of tourist cars have been placed by the Canadian Pacific Railway Co. between Boston, Montreal, Toronto, and Vancouver. They are the handsomest tourist sleepers ever built, and are highly creditable to the C.P.R. Company's shops, Montreal, at which they were constructed. They are 72 feet long, and contain fourteen compartments, seating fifty-six passengers. They have complete kitchen and toilet arrangements, and spacious smoking-rooms. The seats are so constructed as to leave ample room beneath them for hand baggage. With the exception of being upholstered in leather instead of plush or velvet, and with interior fittings of birch instead of mahogany, they might easily be taken for first-class sleepers.

Alexander McKenzie, professional beggar, who was once an electrical engineer, has invented a successful device for the protection of the third rail on the elevated tracks in New York, and will, it is believed, receive the prize of $100,000 offered by the Interborough Company for that achievement. For several years he has been a conspicuous figure on the platforms of the elevated stations. He has but one leg, and always sat on the floor, with his crutches lying in his lap, and his hat stretched out for coins. At intervals he would be arrested and sent to jail, where he was always a welcome prisoner, for his mechanical genius found great opportunity about the shop and buildings. During his periods of confinement he perfected the models for protecting the third rail, and distrustful of every person who attempted to examine them, finally called upon the Charity Organization for help. The officials at once took charge of the matter, and are pushing his claim.

The first railway in Iceland will probably soon be begun by an English company recently formed for the purpose of working the sulphur mines at Theistareykir, in the north of Iceland. The mines are about seventeen miles from Husavik, the nearest harbor, to which the proposed railway will run.

The C.P.R has given orders for three large steam shovels and fifty ore cars. The former are to be made outside the company's works, the latter will be built at the company's own shops. The consolidated shops, when completed, will be able to build all the company needs in engines, passenger and freight cars.

The Kingston Locomotive Works have sent to the St. Louis Exposition an engine it has built for the Prince Edward Island Railway. Though small, it is said to be the best piece of workmanship ever turned out by the works. Several others like it are to be built. The works are installing a hydraulic riveting and flanging plant. It comprises a riveting machine of 150 tons pressure, a hydraulic frame, accumulator, flanging press and all the necessary pumps, etc. It will be one of the largest plants of its kind in the world. It is furnished by the Chambersburg, Pa., Engineering Co.

City Solicitor Mackelcan, of Hamilton, has a plan to do away with the constant complaints about the noise and dirt created by railway companies in shunting and switching trains. It is to have the railways substitute electric power for steam in moving freight cars within the city limits. The proposal was made some time ago, but was considered impracticable because of the lack of electric power, but the Cataract Company is in a position to furnish all the power required, and the City Council may ask the Railway Commission to pass an order requiring electric power to be used instead of steam.

The Central Trunk Railway Co. is applying for incorporation at Ottawa to build a road from Gaspe to the Georgian Bay. Their proposal is to build from Gaspe Basin to Paspebiac, to buy out the Atlantic and Lake Superior line, thence to Metapedia, to build an airline from Metapedia to Riviere du Loup, saving seventy miles over the Intercolonial route. They would use the I.C.R. from Riviere du Loup to Levis and the Great Eastern and Montreal and Sorel lines thence to Montreal, build a new bridge at Montreal, and either buy or build to the Georgian Bay. Their idea is to open up a large shipping business at Gaspe Basin, which is open to navigation ten months in the year.

The C.P.R. caused a mild surprise within the past month by setting a large number of men at work grading an extension from Sudbury to Toronto. The survey for the extension was made by the C.P.R. seven or eight years ago, and provides for a line running south-easterly from Sudbury through the Nipissing District, touching Byng Inlet, Parry Sound, Bala, and Barrie, and south-westerly to Kleinburg, a station on the Owen Sound branch, twenty-one miles from Toronto. The distance is about 200 miles. It is thought action has been taken at this time to forestall Mackenzie and Mann, who purpose building the James Bay road from Toronto north to connect with the Canadian Northern, but this the C.P.R. authorities deny, and say their purpose to build the Sudbury connection has been announced for a long time. Mackenzie and Mann allege that the C.P.R. people have allowed their charter to lapse, and that they cannot build without securing a special Act of Parliament similar to that held by the James Bay Co. The C.P.R.'s claim is that it can build under that clause in the charter which permits it to build a branch from the main line to any point in Canada. The road will be an expensive one, as it passes through a rough Laurentian country, but there is no thought of asking for any assistance from either the Provincial or Federal Government. There is now imperative reason for the C.P.R. to build this independent connection, owing to the Grand Trunk Pacific being undertaken. Mr. Mackenzie declares emphatically that, whether the C.P.R goes on or not, the James Bay line will be built, and that it will be begun at once. It will probably pass to the east of Lake Couchiching.

The Canadian Pacific is to build new shops at Iberville, Que.

About 300 men are at work double tracking the G.T.R. between Paris and London.

A compressed air locomotive in Dominion No. 2 colliery, Nova Scotia, hauls 35 loaded cars.

Delorimier, a suburb, proposes to give the Montreal Street Railway a twenty-five year franchise.

It is the intention of the Winnipeg Street Railway Co. to have all their cars built in that city in future.

It is announced that the Ottawa and New York Railway shops will be moved from Santa Clara, N.Y., to Ottawa.

The Hamilton Radial Railway Co. is asking permission from Saltfleet Township to double track its line across the Beach.

The C.P.R. has awarded contracts for their new lines to be built in the west this year to a firm of St. Paul contractors.

A number of Fort William business men propose forming a company to build and operate an electric street railway in that town.

The C.P.R. between Toronto and Smith's Falls is to be relaid this summer with new 80-lb. rails instead of the 72-lb rail now in use, at a cost of about $50,000.

The Canadian Pacific Railway has added eleven Saxon consolidation engines to its equipment, most of which are in operation between Toronto and London.

The Ottawa, Brockville and St. Lawrence Railway Co. has had the time for the completion of its direct line between Ottawa and Brockville extended to 1908.

The White Horse, Kluane and Northwestern Railway Co. is applying for incorporation to build a line of railway from White Horse to Kluane Lake in the Yukon Territory.

A new railway bridge has been built at the Narrows, near Orillia. It is strong enough to carry the heavy Mogul engines which it is proposed to place on this division of the Grand Trunk.

A train on the Great Western Railway recently eclipsed all records for the conveyance of American mail between Plymouth and London, covering the distance of 247 miles in 237 minutes. The last 118 miles was made in 99 minutes.

Japan has astonished the world's railway experts with the rapidity of her construction work in Corea. The permanent character of the roads shows a confident expectation that they will be made to serve economic uses as well as military necessities.

The Witness says the Grand Trunk has given an order to the Montreal Machinery and Locomotive Company at Longue Pointe for ten enormous locomotives, to be followed by ten more, which are to be finished before the end of the season. Its own shops are not able to supply new engines fast enough.

The Dominion Government has purchased the Canada Eastern Railway, from Fredericton to Newcastle, N.B., 136 miles in length, and made it part of the Intercolonial. It was built by Alex. Gibson and subsidized by the Dominion and Nova Scotia Governments and the municipalities. The price paid is understood to be $800,000.

The Railway Commissions have issued an order with respect to the crossing of the Grand Trunk at Lindsay by the Lindsay, Bobcaygeon and Pontypool Railway. Each railway is to have interlocking semaphores, but the Grand Trunk is also to instal derailing appliances. The Lindsay, Bobcaygeon and Pontypool Railway expects to be ready for operation by August 1st.

There seems a prospect of a new electric road between Montreal and Ottawa being proceeded with at once. Col. F. M. Mullen, of New York, is the president of the Ottawa River Railway Co., which holds the charter. The motive power is to be both electricity and steam; for the production of the former the Ottawa river will be used. The system will ultimately be extended to the Georgian Bay.

J. D. McArthur, of Winnipeg, has been awarded the contract for five hundred miles of the Canadian Northern to Edmonton. The work includes grading, bridging and track laying.

Contracts for the Trans-Andean Railway have been divided between Clark Co., Spearson & Son, of London, England, and W. R. Grace & Co., of New York, the total amount being $6,750,000.

The Toronto Railway Co. promises to place ninety new cars on their road before autumn. Their shops will be enlarged to build them. They will be of the combination type. The company has been sending cars to Winnipeg contrary to their agreement with Toronto.

Work has been commenced on the Peterboro' street railway. The old road-bed is being torn up, and the new track will be laid as quickly as possible. Mr. Learmouth, of the American Cereal Company, has been appointed manager, and Mr. Edward Burch, of Minneapolis, consulting engineer.

Foley Bros., Larsen & Co., being the lowest, have secured the contract from the C.P.R. for the new lines in the North-West which are to be built this summer. These comprise twenty-five miles east from Wetaskiwin, twenty-five miles of extension east from Lacombe, and forty miles from Pheasant Hill, known as the Lost Mountain section.

The Kingston and Dominion Central Railway is applying for incorporation to build a railway from Kingston through Newboro' and Westport, thence in a westerly direction to some point on the Georgian Bay between Parry Sound and Midland, with power to lease or amalgamate with the Canadian Pacific, the Grand Trunk, or the Brockville, Westport and North Western Railway Company.

Premier McBride, of British Columbia, has promised the British Columbia Northern and Mackenzie Valley Railway a bonus if a guarantee is given that the road will be built within a reasonable time. The proposed railway will traverse the northern parts of the Province, and act as a feeder for the Grand Trunk Pacific. It will enter the gold camps on the Peace, the Liard, the Stickine and the Skeena Rivers, and will give direct railway communication between Dawson and Port Simpson.

Surveys have been commenced on the Stratford-St. Joseph electric railway. The preliminary plans call for a line from St. Joseph, through the village of Zurich to Hensall, ten and a quarter miles; thence to Chiselhurst, four miles; thence to Fullarton, twelve miles; thence through Carlingford to Avonton, and, following the Avon River, to Stratford, a total distance of 38 miles. There may be modifications to avoid heavy grades when the surveys are completed, but this will be substantially the route.

Among the railway charters applied for at Ottawa this session is one for an electric road from Thorold to Port Colborne, thence north-west to Brantford and east to Buffalo. It is promoted by the Wolvin Syndicate, which is running a line of big steamers between Montreal and Duluth, and wish to provide facilities for passengers to visit Niagara Falls, etc., while the boats are passing through the Welland Canal. The Falls will be reached by the Niagara, St. Catharines and Toronto Railway.

MARINE NEWS.

The French steamer Auguste Marie was crushed in the ice and sunk off the coast of Cape Breton.

A new screw steamer, the Sovereign, has been launched at Peterboro' to ply on Rice Lake and the Trent waters.

The Montreal Transportation Co. will rebuild the burned steamer Advance and use her on the lakes as a coal carrier.

The corporate name of The M. Campbell Fanning Mill Co., of Chatham, Ont., has been changed to the Manson Campbell Co.

J. J. Hill is reported to be arranging for a fast steamship line from Vancouver to Skagway.

Steel is slowly but surely displacing hemp as the material of which all hawsers and ropes are made in the ships of the British fleet.

The Quebec Steam Whaling Co., headquarters at Montreal, has been incorporated to carry on operations in the Gulf and River St. Lawrence.

The North American Transportation Company has obtained the contract to maintain the ferry service between Campbelltown and Gaspé, on the Baie des Chaleurs.

There will be four steamers plying between Barry's Bay and Havergal this season, besides a number of barges carrying the output of the Canadian Corundum Co. and Ontario Corundum Co.

A new steamer, the Elgin L. Lewis, is being built at Orillia. The timbers were prepared at Penetanguishene, and taken to Orillia to be put together. She will run on Lakes Simcoe and Couchiching.

A contract has been awarded by the United States for a second canal through the St. Clair flats. The sinking of a vessel in the channel last fall caused much inconvenience, and a second canal will prevent a repetition of such a state of affairs.

A contract has been awarded to Simon McGregor, of Dalhousie, for a wharf at Petit Rocher, in Gloucester, N.B., to cost $60,000. John D. Warwick has been awarded the contract for repairs to the wharf on the Ottawa river at Cumberland, to cost $6,000.

A Kingston dispatch says it is the intention of the Ontario Electric Railway to run its own boats for carrying freight from Kingston to Montreal till such time as the road is extended to that point. Through rates will thus be given at, it is said, about half present rates.

The Star Line Company have purchased a boat for the Gagetown-Fredericton route from the Richelieu and Ontario Company. She is a twelve-mile, single screw boat of oak and hard pine, allowed to carry 250 passengers, and with ample freight accommodation. Her name is not stated.

On the opening of navigation, 1904, the illuminant in the following lighthouses in the river St. Lawrence was changed from petroleum to acetylene, and the lights will henceforth be unwatched, but in other respects unchanged: Lindoe Island, Gananoque Narrows, Jackstraw Shoal, Spectacle Shoal, Red Horse Rock, Burnt Island.

George Yale has been appointed mechanical superintendent of the Montreal Harbor Works, in succession to Mr. Bayfield, who resigned to take up private practice as a civil engineer. Mr. Yale has been for nearly fifteen years mechanical superintendent of the dredging fleet of the Lachine Canal.

While some Collins Bay people were out on the Bay of Quinte in a gasoline launch it exploded and took fire. Those on board had to jump overboard, where they held on to the blazing vessel till rescued by a skiff, their hands being badly burned. A good many accidents from gasoline launches seem to occur, showing the necessity of understanding them and exercising great care.

Glace Bay harbor is to be opened and improved, the Dominion Government having voted $25,000 and the Dominion Coal Company will probably expend $65,000 more in rebuilding shipping piers, dredging, etc. At one time 25,000 tons were shipped from this port in one season, and that was some years before the coal trade had reached anything like its present proportions.

The application has been renewed by the Great Lakes and North-West Transportation Co. for power to construct canals and improve navigation between Lake Superior and Red River at Winnipeg, and thence by Lake Winnipeg or other channel to the Saskatchewan River, to improve the navigation of the Saskatchewan and its branches, providing a transportation route from the head waters of that river to Lake Superior. This is a somewhat ambitious scheme covering a large part of the continent.

The Catherine C. [illegible] Sturgeon Falls, is a new addition to the fishing fleet of W. A. and H. N. Cockburn. She was built under the supervision of Capt. Gidley, of Collingwood.

Canadian Lines, Limited, recently incorporated at Ottawa, in which Wm. Mackenzie, of Mackenzie & Mann, is interested, contemplates a line from Quebec to France and other European countries.

A. M. Whitney, of Boston, has offered the Canadian Government, upon a royalty of $100,000, the right to use along the St. Lawrence the submarine alarm service which is controlled by his company in Boston.

Vancouver is to have a floating dry dock to cost over a million dollars. Construction of the steel frame has been commenced in England. E. E. Ling, consulting engineer representing New York capitalists, has been in Vancouver.

The navigation of the St. Lawrence is to be improved at Cap la Roche. There are two plans, one for dredging and one for a dam which would involve an outlay of about $6,000,000. The former will probably be adopted, on the report of Mr. Wisner, one of the most eminent authorities on the continent.

The Allan steamship Ionian was the first mail boat to arrive at Montreal this season, which she reached May 1st after being detained forty hours by fog and ice. Navigation on the St. Lawrence route has been much impeded by ice this year, and a number of vessels had to go to Halifax to unload.

The Sincennes-McNaughton Co. has added another vessel to its Montreal fleet. It was built at their works at Sorel, and is named the F. Dupre. It is one of the most powerful craft owned by the company, is 80 feet long, 20 feet beam, with 10½ feet draught, entirely of steel, engines with cylinders 18 inches by 36 inches, 24 inch stroke, the total cost amounting to $30,000.

A new boat, the Ottawa, has been built to take the place of the Olive on the Rideau Canal. She is 110 feet long and 24 feet beam, and is a three decker. The hull is of steel and the framework double, so that she is as strong as any of the vessels on the great lakes. She has a fore and aft compound engine of the latest design, and a boiler capacity of 135 pounds. The Olive will be broken up.

The Canadian Shipbuilding Company, promoted by prominent Toronto capitalists, which last year obtained concessions from the commissioners of the Queen Victoria Niagara Falls Park and commenced the construction of an extensive shipbuilding plant on the bank of the Niagara River, just below Bridgeburg, has ceased operations for the present.

The contracts for building the turbine steamers for the Cunard Steamship Company have been placed with Brown, of Clydebank, and Swan & Hunter, of Newcastle. The machinery will be 300 tons lighter than that of reciprocating engines. They will maintain 65,000 indicated horsepower, and the vessels will have a speed of 24½ knots in all weathers. Each will have four shafts. The boilers will be of cylindrical type. The coal consumption will be over 1,000 tons daily. The length of the steamers will be 700 feet.

Steps are being taken in New York to organize a company to build a vessel that will cross the Atlantic in three days. The inventor of the plan is Rich. Benj. Painton, and the means of propulsion is what is termed a multiple electric propeller. The device consists of a series of propellers arranged along the sides of a vessel and driven at great speed by electricity. For a torpedo boat destroyer the size of those at present in use in the United States navy twelve propellors would be necessary, six on each side. In addition, single or twin screws could be provided, to be operated alone, or jointly with the side propellers. The plan is to build a vessel 600 feet in length, at a cost of about $2,000,000. The inventor claims that forty knots an hour can be made. Steamship propulsion now consumes 3,000 tons of coal, at a cost of $18,000 a trip to Southampton. The electrical ship will reduce the coal consumption to 1,500 tons, being a saving of $9,000 on each trip.

The steamer White Star, the upper works of which were destroyed by fire at Toronto last summer, has been purchased by the Montreal and Cornwall Navigation Company. She was towed to Cornwall and will be rebuilt there.

The Dominion Government has decided to place two ice-breaking steamers on the St. Lawrence between Quebec and Montreal. There will be one big steamer to keep the channel at Cap Rouge, the most dangerous spot in the river, clear of ice during the entire winter, and a smaller steamer between Sorel and Montreal. While nothing has been decided upon definitely, it is thought that a vessel measuring 200 feet long, 43 feet beam, and drawing 18 feet of water will about fill the bill. Armstrong, Whitworth & Co., of Newcastle-on-Tyne, will probably be the builders, as they have had more experience than any other company, they being the builders of the Russian ice-breaker Ermak and other large vessels. The Ermak is 305 feet in length, 71 feet beam, and 42 feet 6 inches deep, so that the vessel proposed for the St. Lawrence is considerably smaller. The ice-breaker will be utilized during the summer for lighthouse and buoy work, and possibly for wrecking. The sum of $300,000 has been placed in the estimates for the vessel. It is expected she will be ready for next fall. The Armstrong & Whitworth Co. state that the experience with these ice-breakers has been very satisfactory.

At the first session of the Merchant Marine Commission, authorized by the United States Congress to consider and recommend legislation for the development of the American merchant marine, C. B. Orcutt, president of the Newport News Shipbuilding Company, told the commission that ships can be built in England at from 50 to 75 per cent. less than they can be built in the United States. A ship costing $400,000 there can be built in England for $100,000, he said. The cause of this great difference was that 25 per cent. more is paid for labor in the yards of the United States than in Great Britain, and at the same time there is 40 per cent. in the cost of material in favor of English builders. He said that the protective tariff was responsible for the difference in cost of material. Lewis Nixon, the shipbuilder, said builders in the United States had been constructing too good ships for American use. "Suppose you should take the duty off all shipbuilding materials, do you think that would be any benefit?" asked Senator Lodge. "You would have to take the tariff off everything, because everything goes into a ship. If we had free material and free ships we should have to have free labor, too, because you recognize that labor is paid as well."

LITERARY NOTES.

The following publications have been received at the office of the Canadian Engineer:

"Modern Air-brake Practice: Its Use and Abuse," with questions and answers for locomotive engineers and electric motormen. By Frank H. Dukesmith, inventor of the Dukesmith air-brake release signal. F. J. Drake & Co., Chicago; $1.50. A useful book for railway men and mechanics.

"Easy Lessons; or the Stepping-stone to Architecture." A series of questions and answers explaining the principles and progress of architecture. By Thos. Mitchell. The Industrial Publication Co., New York; 50 cents. A handy book of reference and information for architects and others.

"Transactions of the Engineering Society of the School of Practical Science, Toronto." This is Vol. XVII. of the issue of these transactions, and contains papers covering a wide field read before the society; 50 cents. P. M. Sauder is corresponding secretary of the society.

"The Currents on the South-eastern Coasts of Newfoundland." Compiled from tidal and current surveys, and published by the Department of Marine and Fisheries, Ottawa.

"The Iron Age Directory, 1904." Classified index of goods manufactured by advertisers in the Iron Age.

"Martin's Up-to-Date Tables, for Use Throughout the Empire: Weights, Measures, Coinage." Compiled by Alfred J. Martin, F.S.I.; published by T. Fisher Unwin, London, E.C. Also, Martin's "Up-to-Date Beginners' Table Book for Schools and Home Teaching." A supplement to above. Price, 1d. Very useful little books.

"The Cement Age: The Many New Uses and Increasing Demand for Plastic Materials." By R. W. Lesley. A paper read before the Engineers' Club of Philadelphia, November, 1903.

"Clarkson Bulletin, April, 1904." Information respecting the Thomas S. Clarkson Memorial School of Technology, Potsdam, N.Y.

CANADIAN ELECTRICAL ASSOCIATION.

Arrangements are well in hand for the annual convention of the Canadian Electrical Association, to be held on the 15th, 16th and 17th inst. at the Royal Hotel, Hamilton. The following are the main items of the programme:

June 15th.—a.m.—Meeting of Executive Committee.
Welcome by Mayor on behalf of citizens of Hamilton.
Opening session.
p.m.—Business, Papers and Question Box.
Evening.—Papers.

June 16th.—a.m.—Visit to sub-stations, Deering Works and Westinghouse Works, Papers.
p.m.—Papers, Question Box, election of officers and unfinished business.
Evening.—Annual banquet.

June 17th.—a.m.—Visit to St. Catharines, DeCew Falls (luncheon) and Niagara Falls by courtesy of Hamilton Cataract Power, Light and Traction Co.

The following papers will be presented:

"Origin and Development of Storage Batteries," E. B. Walker.

"The Curtis Steam Turbine," Frank C. Smallpiece.

"Statistics of Canadian Progress in Electrical Application," George Johnson.

"Heavy Electric Traction by Alternating Currents," P. M. Lincoln.

"The Toronto and Niagara Power Development," with lantern illustration, K. L. Aitken.

A recent accident in Nova Scotia has drawn attention to the danger of the old plan of hoisting men from the pit in tubs or buckets. In many cases there are no indicators in the engine room, and it is understood that the mines department will make the provision of indicators compulsory.

The Industrial Advocate says the old time arrastra is being introduced in the gold mines of Nova Scotia, one being in use at Clam Harbor. It has the very great merit of cheapness, being nothing more than a circular stone of granite revolving in a cast iron pan and its weight is sufficient to break up ordinary ore. Many mining men claim that for free gold milling the arrastra gives results that cannot be approached by modern stamp mills, and refer to the absence of slimes and flouring of the gold. It is much used in the older Spanish mines in Mexico and other places.

R. C. Coutlee, Aylmer, Que., has been appointed good roads instructor by the Nova Scotia Government.

Stollmeyer, the Pitch Lake king, who made a fortune out of asphalt, is dead, at the age of 91. He came to America as a penniless German immigrant.

—The Canadian Association of Stationary Engineers, Toronto, No. 1, will hold their annual meeting in Toronto on June 15th for the election of officers, delegates to the annual convention, to be held in Hamilton, Ont., in August, and other business.

The Canadian Engineer

Vol. XI.—No. 7. TORONTO AND MONTREAL, JULY, 1904. (PRICE 10 CENTS / $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY, MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada, Great Britain and the United States, $1.00 per year, foreign, 6s. Advertising rates on application.

OFFICES—18 Court St. Toronto ; and Fraser Building, Montreal.
Toronto Telephone, Main 1310. Montreal Telephone, Main 2589.
BIGGAR-SAMUEL, LIMITED, Publishers,

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 15th of the preceding month or if proof is desired, 4 days earlier.

CONTENTS OF THIS NUMBER :

CANADIAN ENGINEERS ON THE G.T.P.

It was well that the Dominion Government appointed a well-qualified judge to determine the charges made from one end of the line to the other that the management of the Grand Trunk Pacific have loaded up the engineering corps of that road with men from the United States while the applications of well-qualified Canadians for positions on the staff have either been ignored or "placed on file." It was well that the Government appointed an impartial jurist to investigate these charges, but it would have been better had it taken a simple precaution that would have made these charges impossible. Before the agreement with the company was ratified by Parliament the Canadian Society of Civil Engineers conveyed to Government a resolution respectfully expressing the hope that Canadian engineers would be employed on this work. It was naturally to be expected that upon a work which was to receive such a valuable franchise and such signal favors from the Canadian Parliament and people every care would be taken to employ Canadian brains and labor; but in case this should not be sufficiently obvious to both parties concerned the society gave the reminder. Considerations of self respect probably restrained it from going further, and we find it taking no further action than to have the investigation watched by a legal gentleman. The relations of the society with the American Society of Civil Engineers have always been of the most cordial character, and it does not appear that the unfriendly alien labor law passed by Congress as a bad example for this country to follow ever had any general sympathy in that society. At all events, until alien labor legislation was put into force in the United States there was no jealousy towards Canadian engineers who sought employment there. In fact, many members of the Canadian society have profited by United States experience, and still more have attained to high positions on United States roads, and have remained permanently in that country. These facts, however, are in themselves a sufficient answer to the fears expressed by officers of the Grand Trunk Pacific as to whether Canadians of ability and experience could be found to do the work of surveying and locating. Mr. Hays, the general manager, may not share the view of many who contend that an enterprise of such a national character and so heavily subsidized should be a special training field for native Canadians; but few of his critics will credit him with such short-sighted partizanship in favor of his former fellow-citizens as appears to have been displayed by the chief of locating engineers he appointed. Mr. Hays is usually a correct judge of men, and the appointments he has made in the Grand Trunk—notably that of promoting Joseph Hobson, a Canadian, to the chief engineership —have shown a discernment that rarely errs. He knows also that a Canadian engineer built the Hoosac tunnel as well as the St. Clair tunnel, and knows that if Canadians could locate such difficult lines as the Intercolonial and Canadian Pacific they can locate this. Mr. Hays appears to have made one serious mistake in appointing a citizen of another country to the position of chief engineer of the G.T.P. It is true that he first offered the position to Mr. Lumsden, a Canadian, but that gentleman having declined it was given to Mr. Stephens, an American, at $7,500 a year, There were other Canadians besides Mr. Lumsden who were quite qualified for the place, and had it been given to any Canadian the subordinate appointments, whether given to Canadian, British or American engineers, would never have raised any serious question. But it appears from the evidence before Judge Winchester that Mr. Stephens and his appointees, such as Mr. Kyle in the West and Mr. Knowlton in the North Bay division, made it more or less a practice to allow applications from Canadians to remain unacknowledged, or to inform them that their offer would be put on file for "future consideration" (the future never seems to have had a period) : and where appointments were made Canadians received $150 per month, while men from the United States were paid $175 for precisely the same work. Mr. Stephens appears also to have paid scant respect to the judge. He was expected to give evidence at Edmonton, but promised to appear at Winnipeg. He failed to appear

before the judge when the court sat at Winnipeg, and promised again to appear at North Bay, but once more failed. One cannot anticipate the judge's findings, but Mr. Hays has probably seen enough already of the state of affairs in the engineering staff to realize that with a Canadian as chief the subordinate appointments will be accepted without undue criticism, and that until such appointment is made there will be just ground for dissatisfaction.

—The signs of the times appear to point to a general acceptance of the principle of municipal ownership of such utilities as water, gas and lighting and to the public or Government ownership of such franchises as the telephone, telegraph and railways. A single service well administered and on the cheapest terms consistent with good maintenance and a moderate return on the capital invested is manifestly the most satisfactory to the public, and when that moderate margin of profit is returned to the general public from whose needs it derives its existence the ideal has been reached. But the conditions for this ideal are farther away under private than municipal or public ownership. Where more than one company is in the field for a service in a city, for instance, the natural struggle to obtain complete control leads to the buying out of the opposition at a price many times beyond its earning power, and no sooner is the victorious company seated in its monopoly than rates are raised sufficient to pay a dividend on the inflated capital; in other words, on paper that represents no conceivable value, either in plant or good-will. The income from these non-existent values is transferred from the pockets of the citizens in general to the few of them who have been in the deal, while, on the other hand, the service, when the opposition has been removed, is usually poorer than before. Under municipal ownership the acquisition of the rights of existing companies is apt to be obtained upon terms that represent something like the actual value of the plant, and there is no danger of further watering of stock, since the people have no object in exploiting themselves. As for the quality of the service, it can be made just as efficient as the people desire, since the control is in their own hands. It is true that corruption gets into municipal politics too often and too deeply, but this again is capable of cure, and the evil will work itself out in time. The evil, on the whole, is probably not greater than the corruption and dishonesty that exists among the employees of private corporations owning large franchises. Municipal management in the cities of Canada has extended a great deal in the past ten years, as it has also in Great Britain and the United States, and with a few exceptions the change has been for the public advantage. In view of this tendency it is satisfactory to learn that the Dominion Government is considering the acquisition of both the telegraph and trunk line telephone systems of Canada. Sir William Mulock, into whose department the work would fall, has not only been capable of "thinking imperially," but of acting imperially in working out his postal problems; and if he takes control of the telephone and telegraph services he can count on having the support of the people who will be relieved from a situation already full of danger and irritation, and which is bound to grow worse as such monopolies as the Bell Telephone Co. extend their sway. There is very little prospect of relief from the formation of rival telephone companies, since sooner or later the Bell will buy them up, and the telephone-using public will be bled to pay for the deal. The only remedy for the telephone trouble is Government ownership of the trunk lines, with the extension of municipal ownership, if not Government ownership, of local exchanges.

K. B. THORNTON.

K. B. Thornton, now president of the Canadian Electrical Association, is the youngest man (with the exception of Mr. Gossler), who has held this position. He has a good education, part of which was obtained in England. For a number of years he has been superintendent of the Construction Department of the Montreal Light, Heat and Power Co. Mr. Thornton was 1st vice-president of the Association last year, and held the 2nd vice-presidency the year previous.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Two branches of the above association have been organized recently, one at Chatham, on the 28th May, and one at St. John, N.B., on the 23rd June. The former started with ten charter members: Wm. Condon, Thos. Stephenson, John Buck, Albert Trott, Chas. Kelley, R. G. Brown, Edw. Grandbois, Wellington McGregor, Wm. Prout, and J. W. Montgomery. The St. John branch starts with 43 charter members and both organizations promise well.

NEW CATALOGUES.

The following catalogues may be obtained by those interested, by referring to the Canadian Engineer:

"Metal-Working Machine Tools." Garvin Machine Co., Spring and Varick streets, New York.

"S.K.C. Generators," Bulletin 923, Canadian General Electric Company, Toronto.

"Compressed Air Appliances," The Canadian Rand Drill Co., Sherbrooke, Que.

—The Decimal Association of England is offering prizes of £20 and £10 for the two best essays on the advantages to be gained by the adoption of the Metric Weights and Measures throughout the British Empire, and on the best means of effecting the transition. Essays must be in by January 1st, 1905. The secretary is Edward Johnson, Oxford Court, Cannon St., London, E.C.

A. A. WRIGHT, M.P.

A. A. Wright, M.P., first vice-president of the Canadian Electrical Association, was born at Farmersville (now Athens), Ont., June 16th, 1840. He received his education at Athens Public and High Schools, and Toronto Normal School, after which he became head master of the Gananoque Public School. In 1865 he entered the Military School, at Montreal, obtaining a first-class military certificate. In 1870 he went into mercantile life at Renfrew, Ont., and in 1886 entered the electrical field by installing an arc plant in that town. This was later supplemented by an incandescent plant, and the business is now carried on by the Renfrew Electric Co, Limited, of which Mr Wright is president.

Mr. Wright was a charter member of the Canadian Electrical Association, and has been an active member since its organization. In 1899 he was elected member of the House of Commons, which position he still holds.

LIGHT, HEAT, POWER, ETC.

The Niagara Falls Park Commission has approved the plans of the Ontario Power Co. for their power house at the foot of the Falls, and for the gate and screen houses at the intake.

Natural gas has been struck at Medicine Hat, N.W.T., at a depth of 1,010 feet. The flow is estimated at 1,500,000 cubic feet a day. The strike was made by the commissioners for the proposed municipal gas plant.

The Toronto and Niagara Falls Power Company has awarded a contract, which calls for six generators of 7,500 kilowatts capacity each, or 45,000 kilowatts in all. The Canadian General Electric Company secured the contract.

The plant of the Kingston Light, Heat and Power Co. is to be taken over by the city August 1st, the company to pay taxes to that date and costs of the appeal against the award, while the city agrees to continue to supply power to the Street Railway Company at $2 per car per day for six months.

The Canadian Westinghouse Company have closed a contract to furnish the Shawinigan Water and Power Company, Shawinigan Falls, with a 6,000 K.W., two-phase 2,200 volt 3,600 alternations, 180 R.P.M., rotating field alternator, for direct connections with water wheel. Two 2,200 K.W. oil insulated water-cooled transformers, 2,200 volt primary, 50,000 volt secondary, are included in the contract.

At the annual meeting of the Ottawa Electric Co., last month, a net profit for the year of $47,734, was carried to credit of profit and loss; $25,000 was added to the rest account, and $25,000 laid aside for depreciation. There was added during the year 12,524 incandescent lights, 99 arc lights, 23 power motors, and 610 other customers. Thomas Ahearn was elected president; F. P. Brown, vice-president, and D. R. Street, sec.-treasurer.

The suit of the Minnesota Canal Power Co. vs. Koochiching Power Co. is about to be heard in Fort Frances. This suit is in connection with the expropriation of lands for the purpose of diverting the water of Rainy Lake and River into Birch Lake and St. Louis River, as explained in The Engineer last month. A strong protest has already been entered by residents and companies on both sides of Rainy River, and it is hoped the United States Government will nip the scheme in the bud.

The Western Electric Mfg. Co. is getting its new works in shape, at Berlin, Ont. Some machinery has been installed and more will be added as business develops. The company is making switch and panel boards and fuses, and later on will make watt meters. It is also preparing to make for the Canadian market a new type of arc lamp, invented in Germany, and said to require less current than any yet devised. The president of the company is Peter Hyman, hardware dealer, and the manager John H. Messner.

The Mexican Light and Power Company, Limited, of Montreal, the $12,000,000 enterprise of which James Ross is president, has just placed the largest single order for copper cable ever let in the States. The order calls for 1,500 miles of cable, weighing upwards of 2,000 tons. The cable is to be built from the company's Necaxa power plant to Mexico City, and from there on to the El Oro mining district, a total distance of some 125 miles, and will be supported on steel towers in spans of 500 feet. The contract for the cable was let to the Ansonia Brass and Copper Company, of Ansonia, Conn. The Mexican Company's construction operations are among the most extensive ever initiated on this side of the Atlantic. The capacity of the Necaxa plant will in the first instance be 45,000-h.p. Eventually there will be installed additional machinery which will permit of the generating of 80,000-h.p. Fully $8,000,000, it is estimated, will be expended before the company begins to transmit the electric current.

THE TARIFF CHANGES.

On the 7th June, the Finance Minister announced a number of changes in the Canadian tariff. Among these it is provided that notwithstanding the preferential tariff, the minimum duty on woolen goods (excepting blankets, flannels and bed comforters), shall be 30 per cent., and on twines and cordage, 20 per cent. The duty on common window glass shall be $7\frac{1}{2}$ per cent., and plate glass, not bended, in sheets or panes, not exceeding 7 sq. ft., shall be 10 per cent., and from 7 to 25 sq. ft., 25 per cent. Paraffine wax candles and paraffine wax are dutiable at 25 per cent.; coal oil costing more than thirty cents per gallon, 60 per cent.; lubricating oils, composed wholly or in part of petroleum, costing less than twenty-five cents per gallon, $2\frac{1}{2}$ cents per gallon; crude petroleum, gas, oils (other than benzine and gasoline), above 40 Beaume gravity, at 60 degrees temperature, $1\frac{1}{2}$ cents per gallon; oils, coal and kerosene, distilled, purified or refined, naphtha and petroleum, and products of petroleum, n.e.s., $2\frac{1}{2}$ cents per gallon; lubricating oils, n.e.s., and axle greases, 20 per cent.; vaseline and all similar preparations of petroleum for toilet, medical or other purposes, 25 per cent.

Among the articles transferred to the free list are machinery and appliances, not made in Canada, for alluvial gold mining, machinery for the manufacture of linen; rotary printing presses of a kind not made in Canada; machinery of a kind not made in Canada for the manufacture of brass goods, such as are mentioned in item 402, schedule B; well-drilling machinery and apparatus of a class not made in Canada for drilling for water and oil (not to include motive power); artificial teeth, quassia juice, crude petroleum, fuel and gas oils, 40 Beaume gravity or less, at 60 degrees temperature (.8233) specific gravity; whole oil soap, hydro-fluo-silicic acid, and glass for dry plates for photographers; also scientific apparatus when imported by order of an educational or scientific institution for its own use and not for sale.

One pargaraph reads as follows: "The provisions respecting a special duty of customs shall apply to imported rolled wire rods not over ⅜ of an inch in diameter, notwithstanding that such rods are on the customs free list. Provided, however, that the special duty of customs on such wire rods shall not exceed 15 per cent. ad valorem."

Provisions are also made intended to prevent the

slaughtering of foreign goods on the Canadian market in competition with home manufacturers.

The term of the free entry of beet root sugar machinery is extended over one year.

The imperial standard gauge has been adopted to determine the classification of metal plates and wire, and will replace the Stubbs' gauge.

INDUSTRIAL NOTES.

Palmerston, Ont., is installing a water supply and sewage system.

Creemore, Ont., is spending $20,000 in installing a gravitation water system.

Springhill, N.S., will put in a supply system by which water will be brought eight miles by gravitation.

The Guelph Foundry Co. have moved into their new four story addition. The foundry now stretches 171 feet.

The Enterprise Foundry Co., of Sackville, N.B., are installing a new plant for the manufacture of steel ranges.

Peter Lyall & Sons have begun work for the steel sheds which they have contracted to erect on the harbor front at Montreal.

Grimsby is raising $34,000 to put in a waterworks system, to consist of a filtering basin and pump house at the beach, and a reservoir on the mountain.

Oshawa, Ont., is granting a ten thousand dollar loan and ten years' exemption from taxation to the Canadian Saddlery and Harness Manufacturing Company, Toronto.

The Manitoba Construction Co. has the contract for the erection of the new gas tank and enlargement of the present works, in Winnipeg. The new tank will be one of the largest of its kind in Canada.

The Verity Plow Company, of Brantford, announce that they will erect large extensions to their factory. The capacity of the works will be doubled, and will employ 250 more men.

The Canadian Iron Co., of Ottawa, has been incorporated with a capital of $2,000,000. The provisional directors are: H. F. Gooderham, H. Barry, and Robert Weir, all of Toronto.

It is said that the Dominion Saw Works are contemplating the establishment of a manufacturing branch in Vancouver. James Robertson Co, Limited, of Montreal, are the proprietors.

The Department of Public Works is investigating the necessity of a bridge over the Saskatchewan, at Medicine Hat. The bridge, which would be cement and steel, would cost about $85,000.

The extensive planing mills of the St. Catharines Box and Lumber Company were totally destroyed by fire on June 25th. The loss will be between $45,000 and $50,000, with insurance of about $30,000.

Brampton has granted a loan of $25,000 to the Copeland-Chatterson Company, of Toronto, who contract to erect buildings to the value of $30,000, and to employ 125 hands, to whom they will pay annually not less than $40,000.

Representations are being made to the Minister of Railways and Canals with a view to the lengthening of Rideau Canal for the benefit of mining operations. Frontenac is rich in feldspar, but must have better transportation facilities.

The Rat Portage Lumber Co.'s factory was destroyed by fire on June 18th. The fire started by a boiler explosion, and spread to a number of adjacent residences. The loss is placed at $140,000. The company is rebuilding at once.

The Canadian Pipe and Foundry Company is the title of a new company recently started in Vancouver, and organized for the purpose of manufacturing wire-wound wooden pipes. J. R. Berry is the manager, and F. A. Shand assistant manager. The company rep[or]t prospects for business very bright.

The city of St. John's, Nfld., is remodelling its waterworks system, under the supervision of John Galt, of Toronto. The water is to be brought by gravitation through a canal a mile long cut out of the solid rock, and is carried by a conduit for two miles further to a receiving basin from which it is distributed by two cast iron mains. The cost of the work will be about $125,000.

The Oshawa, Ont., Steam and Gas Fitting Co., manufacturers of steam and gas pipe fittings, are enlarging their plant by the addition of a two-story building, and a three-story building, with cement flooring, as machine and pattern shops, etc.

J. A. Jamieson, C.E., Montreal, has been instructed by the Minister of Railways to prepare plans for a two-million-bushel steel elevator at Port Colborne to be finished in the autumn of 1905. It is to be constructed to attract to the St. Lawrence route grain shipments that now go by way of Buffalo.

The Canada Iron Furnace Co., of Midland, has a daily output of about 120 tons, and the coke consumption is from 130 to 150 tons a day. The latter is brought by rail from Pennsylvania. The total amount of ore brought, chiefly from Lake Superior ports, is from 50,000 to 60,000 gross tons. The business has been running four years.

Fort Frances is looking forward to large industrial developments in the future. Work on the big dam will commence in a few weeks, followed by the erection of a 5,000 barrel flour mill, a paper mill, a pulp mill, and other industries. American capital is behind the enterprise. Privileges are being granted by the town to industries locating there.

F. H. Clergue, A. B. Wolvin, and W. F. Fitch will erect a coke plant in the Michigan Soo, which will roast not far from 750,000 tons, to supply the surrounding country with the fuel for commercial purposes. It will take 250,000 tons to supply the Algoma steel plant alone. The building of the plant will mean the reduction of $500 per day in the running expenses at once.

Consequent on the death of President Calloway, a meeting of the Locomotive and Machine Company of Canada was held at the company's new offices, Imperial Bank building, Montreal, when a new board was elected as follows: Albert J. Pitkin, Pliny Fisk, G. R. Sheldon, W. M. Barnum, K. E. Blackwell, Roger Miller and D. W. Morrow. The officers elected were: Albert J. Pitkin, president; J. E. Sague, vice-president; R. J. Gross, second vice-president; C. E. Patterson, comptroller; Leigh Best, secretary; G. B. Denny, treasurer. In addition to the improvements in the plant already decided upon and which will cost $300,000, it was decided to erect another addition to the big machine shop which will be 33 feet by 250 feet.

The strike at the works of the Dominion Iron and Steel Co., which practically began on the 7th June, has not yet been broken. The company claim that the wages paid are higher than any paid in New Brunswick or in Nova Scotia, outside of Cape Breton. The men refused the arbitration which was offered by the company, and demanded a return to the wage scale in force before November last. Now, it appears that the men are willing to arbitrate, and Mr. Plummer, president of the company, is about to submit an arbitration proposal to the other members of the board. In respect to membership in labor unions, the position of the company is said to be unchanged. On July 4th, an attempt was made to operate the plant, under the protection of the militia. Serious disturbance resulted, and [m]ore is anticipated. The men claim that if the Coal Company [be]gin to supply fuel to the steel plant, the employees of the [fo]rmer company will strike in sympathy.

A [lo]ng-drawn out case before the High Court, at Hamilton, is that of E. A. Wallberg, who formerly did business as a contracting agent in Toronto, but is now engaged in Ottawa and Montreal, against the Steel Storage Elevator and Construction Company, of Buffalo, for three items of commission for securing contracts for the defendant company. They were: $10,000 on a $600,000 contract for the construction of a steel grain elevator in Montreal; $1,431 on a $95,460 contract for a wharf in Montreal, and $4,500 on a contract for a steel elevator annex for the C.P.R. Company, costing $300,000. The defence was that the contracts had not been secured through the plaintiff, who also had failed to notify the defendants of the commission he expected on the contracts, so that the amount could be included in the deals. The defendants did not consider he was entitled to any commission, as the work was regarded as an advertisement for him. The court's jurisdiction was denied by the defendants. The case was transferred from Ottawa to Cornwall, and from the latter place to Hamilton, owing to the defence not being ready.

CANADIAN ELECTRICAL ASSOCIATION.

The fourteenth annual convention of the Canadian Electrical Association was held in the Royal Hotel, Hamilton, on Wednesday, Thursday and Friday, June 15th, 16th and 17th, the president J. J. Wright, of Toronto, in the chair.

The following registered attendance: From Toronto: J. J. Wright, C. H. Mortimer, A. B. Smith, T. R. Price, J. M. Leamy, W. A. Bucke, R. G. Black, E. Irving, W. W. Bogart, E. B. Merrill, R. H. Fraser, K. L. Aitken, F. Rose, J. W. Campbell, W. V. Warren, E. D. McCormack, Acton Burrows, Frank T. Dryden, W. H. Dudley, John W. Watts, W. H. Fiske, W. D. Wilgar, P. E. Hart, H. O. Edwards, H. G. Nicholls, Walter Nicholls, E. B. Walker, Frederic Nicholls, G. W. Hill, D. H. McDougall, A. C. Larkin, A. E. Esling, F. C. Smallpiece, J. P. Thompson, A. M. Wickens, G. F. Perry, W. R. Scadding, J. Herbert Hall, C. H. Wright, R. T. MacKeen, H. J. Surtees, Roderick T. Parke, A. B. Lambe, W. M. McKay, W. McCaffery, J. F. H. Wipse, E. W. Davies, James Bannon. From Montreal: Henry D. Bayne, A. McLean, Edward F. Sise, A. E. Wilson, J. A. Fletcher, J. M. Wright, W. H. Reynolds, T. J. Mullen, L. Rousseau, G. C. Rough, R. A. Stinson, Paul Size, C. W. Henderson, T. R. Fulton, Cecil Doutre, Alfred Collyer, W. C. Brown, H. W. Weller, W. A. Duft, Fred Thompson, G. F. Olney, D. W. McLaren. From Hamilton: Gordon Henderson, C. K. Green, J. A. Kammerer, H. W. McPhie, Geo. Black, D. S. Henderson, W. C. Hawkins, N. S. Braden, John Patterson, John Knox, John Knox, Jr., H. M. Bostwick, H. P. Douglas, T. F. Niven. From Ottawa: John Murphy, J. Johnston, T. Hilliard, O. Higman, A. A. Dion. Also the following: B. F. Reesor, Lindsay; C. B. Hunt, London; John Yule, Guelph; H. O. Fisk, Peterboro'; R. J. Smith, Perth; W. E. Reesor, Lindsay; W. Williams, Sarnia; J. G. Archibald, Woodstock, Ont.; J. W. Crawford, Durham; C. H. Abbott, St. John, N.B.; H. N. Dignum, Bowmanville; C. B. Roulet, New York, N.Y.; T. H. Bibber, Boston, Mass.; K. Hadin, London, Eng.; T. D. Loneragan, Quebec; R. M. Saxby, Whitby; C. T. Starr, Halifax, N.S.; C. H. Clark, Boston, Mass.; A. F. McBean, St. Catharines; F. C. Whatmough, Stratford; F. Chowen, Stratford; W. H. Wiggs, Quebec; W. L. McFarlane, Cornwall; A. T. Duncan, R. R. Wiley, and R. B. Hamilton, St. Catharines; Louis W. Pratt, Brantford; R. B. Smith, Boston, Mass.; H. Webster, Norwich; W. J. Ingram, Kincardine; Arthur Doddridge, Quebec; L. R. Grimshaw, St. Catharines; A. H. Oesterreich and C. W. Schneidel, Waterloo, Ont.; Chas. L. Farrar, Lakefield, Ont.; Simon Plewes, Creemore, Ont.; J. A. Culverwell, Peterboro'; F. B. Utley and Jas. Buchanan, Galt; G. U. G. Holman, Levis, Que.; J. D. Lachapelle, Sorel, Que.; V. B. Coleman, Port Hope; F. W. Martin, St. Catharines; E. Craig, Niagara Falls, Ont.; T. Beecroft, W. A. Boys and T. H. Bennett, Barrie; J. W. Crosby, Halifax; J. M. Deagle, E. F. Terman, Cataract, Ont.; T. E. Gayfer, Ingersoll; Fred Deagle, Eugenia Falls; P. S. Coote, Chatham; P. M. Lincoln, Pittsburg, Pa.; L. B. Hastings, Pittsfield, Mass.; A. H. Skene, Bracebridge; T. Kelley, Barrie; A. Walker, Bracebridge; W. Langford, Quebec; W. R. Reynolds, Mitchell.

An address of welcome was delivered by Mayor Morden in which he referred to Hamilton's growing importance as a manufacturing and electrical centre. "Once Hamilton was called the Ambitious City; but there is a difference now. It then had an ambition to be great among the cities of Canada; now it is ambitious to be the greatest of them all." He referred to the fact that there were now in operation in Hamilton more than three hundred important industries.

The president then delivered his annual address, in which he referred to the meeting of the Association in Hamilton twelve years ago. This period covered practically the entire development of long-distance transmission of electricity. Hamilton had in that time attained the distinction she now enjoyed as the Electric City, and one of the first cities to minister to the needs of its manufacturers by transmitting electric power from a natural reservoir. Among the imp[illegible] the convention would be the endorsation of the app[illegible] to the Minister of Inland Revenue for the better [illegible] of the resources of the [illegible] Bureau of the Department. The favorable hearing accorded a deputation a [illegible] weeks ago gave encouragement that a further [illegible] would secure increased facilities for protection and [illegible] legislation that would still further protect the [illegible] engaged in electrical enterprises. A committee had been appointed, he said, to confer with the underwriters as to protective devices to be used in the installation of electric appliances; "and it could do good work if it were to succeed in inducing the insurance companies to investigate thoroughly the cause of the many fires that are [illegible] taking place." It had become the fashion now, he said, wherever there were wires in a building to blame all fires upon the electric wires where there was no other obvious reason. The chief of Hamilton Fire Department had estimated that 60 per cent. of all fires were incendiary, but the speaker thought this estimate too low. Gratification was expressed that the legislation requiring a municipality to purchase at a fair valuation the plant of a company with which it would otherwise go into competition still remained on the statute books. Municipal socialism was designated as a passing whim. Theoretically, a municipality should be equal to private enterprise, but practically it was impossible. In some isolated instances it had been accomplished in England with more or less success, but the difference in constitution of municipal bodies in England and in Canada was sufficient to account for the impossibility of such results here. The speaker expressed great satisfaction with the progress of the Association in the past twelve years, both in the matter of growth and in respect to accomplishments of the association as such.

The secretary-treasurer, C. H. Mortimer, then read his report, which announced the appointment of A. A. Dion as editor of the "Question Box," the first volume of which would be distributed at the present convention. A membership of 375 was reported, being an increase of 31 during the year.

On assembling for the afternoon session E. B. Walker was called on to read his paper on "The Origin and Development of Storage Batteries." The paper was as follows:

THE ORIGIN AND DEVELOPMENT OF STORAGE BATTERIES.

By E. B. Walker.

In 1801 Gauthert first observed that if two metals—platinum and silver—were immersed in an electrolyte and a current passed through them, a secondary current could be obtained in the opposite direction by joining the two metals by a conductor.

In 1842 Grove observed that if two gases of strong chemical affinity were connected by pieces of metal through an electrolyte, a current would pass until the two gases were exhausted. In his experiment he used two test tubes inverted over strips of platinum foil in a vessel containing dilute sulphuric acid. The two tubes contained two volumes of hydrogen and one volume of oxygen respectively. On joining the platinum strips with a wire a current passed until the gases in both tubes disappeared. On sending a current through the platinum and acid from a primary battery, the gases were formed again by electrolysis, thus storing a small supply of electricity, represented by the volumes of the gases. About 830 cubic centimeters of hydrogen at a temperature of O. degrees C. and 760 m.m. pressure, being equivalent to one ampere hour. Grove constructed a battery of fifty of these cells and managed to obtain a small arc light.

The year 1850 opens the era of the first storage battery of any practical value. Gaston Plante discovered that if a current were passed through two plates of lead immersed in dilute sulphuric acid a small current could be obtained for a short time, in the opposite direction to the charge, by joining the two plates with a conductor. This was due to

the formation of lead peroxide on one of the plates, causing a difference of potential.

He also observed that by a series of charges and discharges of this nature, and by reversing the direction of the charge each time, the quantity of lead peroxide on one plate was greatly increased, while a spongy surface of pure lead was formed on the other; as this increased the capacity of his battery, he was able to construct a cell that was of some practical value. His method was to roll together two sheets of roughened lead, which were kept from touching by sticks of paraffined wood, and to immerse the whole in dilute sulphuric acid. The cell was then charged, discharged, and charged again in the opposite direction, until the plates were "formed," i.e., a coating of lead peroxide was formed on one plate and of spongy lead on the other. This process occupied a month or two, but after several experiments Plante succeeded in reducing this time considerably by soaking the plates in a bath of nitric acid, previous to the formation process.

Plante carried on his research work until 1879, but he does not appear to have succeeded in sufficiently shortening the formation period of his battery, although he is said to have made some experiments with mechanically applied active material.

FAURE SYSTEM.

As the long and tedious process of formation of the Plante element added much to the expense, it greatly checked the commercial growth of the storage battery.

In 1879, however, R. L. Metzger partially overcame this by mechanically applying to a lead plate active material in the form of a paste of lead oxide. This important improvement was not generally known, until Camille Faure obtained patents on a similar process, which is now known as the Faure system. Faure's first experiment was to cover an ordinary Plante plate with lead oxide but he subsequently improved this by using an antimonious lead grid, with a paste of red lead, and sulphuric acid for the positive and litharge and sulphuric acid for the negative. The advantage of the antimonious lead grid over pure lead will be dealt with later.

COMPARISON OF PLANTE AND FAURE SYSTEMS.

We now have two methods of making a storage battery, both of which have striking advantages, and both, unfortunately, striking disadvantages. In the Plante system the time of formation is long and a large amount of electric power is consumed; the proportion of active material to the weight is small, as the lack of mechanical strength of the lead makes it necessary to have a thick plate to withstand any strain; the lead plate is continually undergoing a formation process from the repetition of charge and discharge, which reduces its strength. On the other hand, the conductivity of the Plante plate is excellent as the active material being formed directly on the surface is always in good contact with its supporting lead plate. The active material is not likely to be jarred off or forced off by the evolution of gases; rapid discharges of heavy currents may be maintained with little or no injury to the plates.

In the Faure system the advantages and disadvantages are almost diametrically opposed to those of the Plante. The formation is quick and may be accomplished in one continuous charge. The proportion of active material to the weight is large, therefore the capacity is increased. The antimonious lead grid has greater strength, and is more rigid than the lead plate. The antimonious lead grid is only very slightly subjected to the "forming" process, and therefore retains its strength.

Here it may not be amiss to explain the term antimonious lead grid. I have used it in a general way to represent those alloys of lead, antimony, arsenic and tin, which have been made with a view to obtaining increased strength and immunity from the electrolytic effects of the current on charge and discharge. Some of these are quite successful, but the manufacturers keep the exact composition secret.

On the other hand, the conductivity is lower than in the Plante, as it is difficult to maintain good contact between the active material and the grid. The expansion and contraction on charge and discharge is apt to loosen the active material and render it liable to fall out. Very heavy discharges are likely to force off the active material by forming gases inside of it.

Since this time the manufacturer has been endeavoring to produce a battery which will combine the advantages of both with none of the disadvantages. Needless to say, this battery has not yet been made, but nevertheless the improvements now existing are such that the storage battery holds an important place in modern engineering practice, and it is safe to say that few, if any, of the larger direct current plants could be considered up-to-date without such an auxiliary.

To enumerate the varieties of batteries which have been patented and manufactured would occupy the remainder of the evening, but it may not be out of place to mention those which present radical improvements or entire departure from standard practice.

METHODS OF MANUFACTURE.

In order to increase the capacity per pound, many methods of increasing the active surface of the lead plate have been devised.

1. Lead plates are scored all over with a sharp tool, which raises fine leaves on the surface and increases the area, in some cases, to 17 times the superficial area.
2. Grooves are cut in a thick plate generally by sawing,
3. Plates are built up of alternate laminae of flat and corrugated lead, which are burned together at the ends.

In these three systems solid ribs are usually left at intervals in the plates, to increase the rigidity, which, however, never equals that obtained by the antimonious lead grid of the same weight.

The advantages of these systems in increasing the active surface are manifest, the drawbacks, however, are rather serious. In all three cases the chief support is pure lead, which, as was mentioned before, is subject continually to a formation process. Thus the thin leaves, ribs or laminae produced by these methods are apt to become formed right through and so break away. Too many ribs or laminae will not allow sufficient room for the formation of the lead peroxide, and buckling or forcing off some of the active material is sure to result.

Plates of this type expand and contract laterally across the surface and consequently are sure to buckle sooner or later, as it is manifestly impossible to keep this expansion and contraction the same for both sides of the plate.

The long formation process of Plante has been overcome to a great extent by the addition of lead dissolving acids or salts. The formation of peroxide or sponge lead is so hastened that the time taken is not much longer than that required for the Faure system. In some cases it has been reduced to fifty hours. Care must be taken, however, to free the plates thoroughly from such chemicals before putting them into use, as otherwise the formation process will continue until all the lead is worn away.

In these ways the Plante plate has been so improved that from a standpoint of capacity and fairly quick formation little is left to be desired, but it must be remembered that the former is only obtained by a sacrifice of mechanical strength.

These methods refer more particularly to positive plates. Negative plates for batteries of these types have been made in a similar manner, although there is not so great a necessity for strength, and consequently the number of ribs is usually less.

The Faure system has resulted in more varieties than the Plante. The chief improvements have been the shaping of the grids so as to retain more firmly the active material and the discovery of pastes which set more firmly than those originally used by Faure. Various attempts have been made to increase the porosity of the active material by the addition of powdered pumice, asbestos, etc. The exact composition of the pastes used in the leading batteries of this type are kept secret.

With all these improvements the initial disadvantages still existed, although to a less degree. The next step was to cast the grid about active material formed into pellets. In the original chloride accumulator, buttons of fused lead

chloride and zinc were set in operation and an antimonious lead framework cast round them under pressure. The formation process removed the chlorine and zinc, reduced the buttons of one plate to sponge lead and oxidized those of the other, to lead peroxide.

This method forms a very serviceable element with the important advantage that the strain caused by the expansion of the active material acts along lines radiating from the buttons and edgewise to the plate, consequently buckling is reduced to a minimum. This type, however, has been abandoned for a more improved pattern.

From these statements it would appear that a plate with the advantages of the antimonious lead grid for strength and non-corrosibility, and of the Plante formation for durability of active material would be the most efficient combination. A few batteries of this type have been constructed, of which I shall mention two.

In one case a framework of antimonious lead is used on which are supported long narrow coils of lead ribbon, giving a large, active surface with a correspondingly large capacity. As the coils are free to expand and contract little chance is left for buckling. On the other hand the lead ribbon is weakened by the continual formation of lead peroxide, and consequently there is a likelihood of its being broken and the whole coil disintegrated.

The most prominent example of this class is made of a lead antimony plate cast under pressure with a series of round holes three-quarter inch in diameter throughout. Into these holes is pressed corrugated lead ribbon coiled into spiral buttons.

Such a plate combines many advantages, the antimonious lead alloy cast under pressure gives the requisite strength and non-corrosibility. The lead buttons are "formed" by an improved Plante method and the expansion due to the lead peroxide wedges them so firmly in the plate that good contact is assured, the strain of expansion acts in a similar way to that described previously in the chloride plate, reducing buckling to a minimum.

The negative plates of all types present fewer difficulties. The expansion and contraction is much less, and therefore the tendency to buckle and to shed active material is diminished. One of the difficulties seems to be a tendency to form lead trees, or fine branches of lead from the negative over to the positive, thus causing a short circuit, unless the growth is removed by probing from time to time. This difficulty and the chance of plates short circuiting, if they are slightly buckled, has caused a great deal of experiment with different kinds of separators and envelopes to protect the plates, various forms of parchment, celluloid, pyroxylin, hard rubber, asbestos-cloth, porous earthenware, and wood have been tried; of these only two are really successful, i.e., perforated hard rubber sheets, and wood. The cost of supplying perforated hard rubber sheets for a large battery is prohibitive, and besides there is always a possibility of short circuiting through the small holes. The wood separator, however, is a decided success. Difficulty was at first experienced by the formation of acetic acid, which is a solvent of lead, but this difficulty has been removed by chemical treatment, and the wood separator is now used by the leading manufacturers.

The manufacturers of the last battery referred to have lately developed a new negative plate, which practically does away with the branching towards the positive, and also the shedding of active material.

This plate is formed of a rigid frame of antimonious lead, with square boxes covered with perforated sheets of antimonious lead; in the boxes are placed square pellets of the active material. The perforated covering so protects this that the expansion and contraction takes place altogether inside and any tendency to form lead trees is thus checked.

OTHER FORMS.

Many novel and ingenious methods have been invented to prevent buckling and the shedding of active material. Among them is the use of earthenware grids, which support the active material and prevent it from any possibility of short-circuiting. While this is interesting from an experimental standpoint, [illegible] the plate has [illegible] greatly increase the [illegible] other form is a battery [illegible] one on top of the [illegible] trays and the whole [illegible] voltaic pile. The [illegible] of keeping the trays properly [illegible] practical use.

Various experiments have been tried [illegible] without any grid. The material [illegible] and on this account graphite has been mixed [illegible] the whole compressed into flat plates [illegible] thin sheet lead, used solely [illegible] prominent example the active material was formed of [illegible] arge and ammonium sulphate pressed [illegible] by various chemical processes this plate was formed into lead peroxide and hardened. A framework of lead was used to support it and to give the necessary contact, making the whole look like a school slate. The capacity was very high, being about 16 ampere hours per pound.

These methods, however, while interesting from an experimental standpoint, are also of very little use, as the active material rapidly disintegrates.

Several batteries have been constructed, in which two different metals are used for the plates. The most notable of these are the lead-zinc battery and Edison's nickel-iron battery.

There is one inherent drawback in all batteries in which two different metals are used, and that is the probability of small particles of one of the metals being carried across to the other, thus forming a local cell. In the lead battery if a small particle of one plate were to be deposited on the other, a local cell would be formed, but action would only take place until the foreign particle was converted into the same material as the plate. This, of course, could never take place in a cell using two different metals.

As regards Edison's battery, very little reliable information can be obtained on certain points. However, most of those who have made tests seem to be agreed. Recent tests made in London show the ampere-hours per pound to be undoubtedly higher than in the lead battery, the average voltage per cell is about 1.2 as against 1.95 in the lead battery. This makes it necessary to use about 70 cells of Edison's battery against 44 cells of lead battery, making a proportion of 5 to 7 in weight for the same watt-hour capacity, in favor of the lead battery. The internal resistance is high, causing bad regulation. The efficiency has been rated as low as 60 per cent., whereas the lead battery is rated from 75 per cent. up. The chief point urged by its advocates is durability; of this quality, however, we have no authentic proof. The writer heard, not long ago, that Mr. Edison had withdrawn his battery from the market, as he is not yet satisfied with it.

In the lead-zinc battery a peroxide plate is used for the positive, and a pure zinc plate for the negative. The advantages are higher voltage (about 2.5 per cell), and about 57 per cent. more capacity per pound in watt-hours. The drawbacks are the difficulties in redepositing the zinc, and in preventing small particles of it from being deposited on the peroxide plate, thus causing local action.

Notwithstanding the numerous varieties of storage batteries which have been produced, we are still limited to the Plante and Faure systems for all commercial work. Each has found its place and to-day the Plante system is almost universally used for stationary work, and the Faure for vehicle work.

There is one particular feature about the Plante battery which renders it especially superior to the Faure type for heavy discharges of short duration, such as are required in the regulation of railway loads, and this is that the capacity of the Plante battery at the one hour rate is 55 per cent. of its capacity at the 8-hour rate, while that of the Faure is only 40 per cent. Among the prominent types of batteries used to-day, the Plante for stationary work has a capacity of about 2.3 to 4.1 ampere-hours per pound of element, and the Faure for vehicle work about 4.8 to 5.0. The Plante negative is little used, as the advantages of this

system, which appear in the positive, are not manifest in the negative. A good negative will often outlast two sets of positive plates.

DISEASES AND THEIR REMEDIES.

(1) Shedding of active material and loss of capacity.
(2) Corrosion of plates.
(3) Buckling.
(4) Sulphatation.
(5) Formation of lead growths from negative to positive.

1. Shedding of active material and consequent loss of capacity is caused by too rapid discharges, forming gases which force out the active material. Loss of capacity is further caused by the formation of excessive lead sulphate, which often clogs the pores of the lead sponge and forms a layer between the grid and the active material. The shedding of active material is also due to the following causes:

(1) Imperfect application of paste.

(2) Overcrowding of active material in the formation of Plante plates.

(3) Discharging at too high rates.

2. Corrosion of plates is caused chiefly by the presence of lead dissolving chemicals in the electrolyte; on this account it is advisable, in replacing loss by evaporation, to use distilled water, unless very pure water is otherwise obtainable.

3. Buckling is due to heavy rates of discharge, which cause unequal expansion. It can also occur at low rates, if the active material is unequally applied.

4. Sulphatation; an excess of lead sulphate is formed when a battery is over-discharged. It can be removed by overcharging at a low rate, but if allowed to remain long after formation it hardens, and on account of its low conductivity cannot be reduced by its recharging.

5. The formation of lead trees, which we have already mentioned, has been overcome by the use of the box negative and wood separators previously referred to.

APPLICATIONS.

There are many more uses of the storage battery than would occur to the layman. The simplest and most apparent application is "straight" storage work, as used in connection with automobiles. The efficiency of this method is not very high, about 75 per cent. being a fair average. However, by intelligent handling much higher efficiency may be obtained, 85 per cent. being about the maximum.

The next example of "straight" storage work is the use of batteries for supplying lights at night, after the generators are shut down. This necessitates some method of controlling the voltage of the battery, which will drop from 2.1 volt per cell at the beginning of discharge to 1.75 at the end, with an average of 1.92 to 1.95. The three standard methods of regulating this discharge voltage are: (1) resistance; (2) end cells; (3) counter E.M.F. cells. The resistance method is the simplest, but it is very unsatisfactory except when lights are burned continually, as every time a light is turned on or off the rheostat handle must be adjusted.

End cells are the most efficient method by far, for on 110 volt circuit 52 cells will be needed at the beginning of the discharge, and 63 or 64 cells at the end. These extra cells are cut in and out by means of an end cell switch. During the greater part of discharge 56 or 57 cells will be in use, the remainder only coming into service at the end, and thus they are only slightly discharged.

There is one drawback in the end cell system, and it is that the different cells require different amounts of charge, necessitating great care on the part of the attendant to prevent overcharging. On this account the counter E.M.F. cell is preferable in small plants, where efficiency is of less importance and where skilled attention is more difficult to obtain.

These counter E.M.F. cells are black grids without active material, immersed in dilute sulphuric acid, and they offer an opposing E.M.F. to the passage of the current of 2.3 to 2.5 volts per cell. The system is no more efficient than the resistance, but the fact that the potential difference of the counter E.M.F. cell only varies between 2.3 and 2.5 volts from any load from one lamp to full load, makes the voltage regulation almost equal to that of the end cell.

Another feature of storage batteries for work of this kind is the necessity of higher charging voltage than the 'bus pressure. The maximum is 2.5 per cell, making a total of 160 volts for a 110 volt battery. Thus extra pressure must be obtained to the extent of 50 volts.

There are three standard ways of accomplishing this, one by cutting the battery into halves and charging in parallel, thus making the total necessary voltage 80, the remaining voltage is cut down through resistance. This of course is very inefficient, but is suitable for small plants where it would be too expensive to install a booster.

The second method is to use a specially wound generator of 160 volts maximum, which will operate successfully at 110 volts. The voltage is raised as the charge proceeds and the discharge voltage controlled by counter E.M.F. cells or by tapping off the battery at the necessary point by means of an end cell switch.

The third method is to use a small shunt generator of 50 volts' capacity termed a booster, connected in series with the battery and 'bus.

REGULATING BATTERIES.

Storage batteries are now very generally used in regulating the rapid fluctuations in railway and other power circuits. Here the battery charges and discharges with fluctuations in the station load and consequently does not have time to reach the higher portion of the charging voltage curve, nor the lower portion of the discharge curve, thus raising the efficiency of the battery as high as 92 to 95 per cent. For work of this nature the battery will require a line voltage which fluctuates more than the battery voltage, or some means of regulating the latter so that the battery may take its share of the load automatically. A highly fluctuating voltage is not usually permissible except out on a long railway feeder where it cannot be helped. A battery installed at such a point will reduce the fluctuations in voltage and by supplying a source of power at the point of application will lessen the copper drop, as loads between it and the power house will be fed both ways.

Where constant potential is required, as when a battery is installed at the power house, a booster with a compounded field or some other regulating device is necessary to regulate the battery voltage.

Many different devices have been patented in the way of regulating boosters. Most of them consist of some system of a series field opposing a shunt field by which the fluctuations of the external load are made to regulate the booster voltage, so that the battery will discharge and charge automatically with the rise and fall of the external load above and below the average, keeping the generator load constant.

It would occupy too much space to give a detailed description of the various styles of boosters, and for the same reason I have not alluded to many of the interesting characteristics of storage batteries.

Mr. Dion in commenting on the paper asked for a statement from the author as to the use of chemically pure acid. "The commercial acid is much cheaper; may it be used?"

Mr. Walker replied that commercial sulphuric acid is often sufficiently pure for storage batteries, but it never ought to be used without previous analysis. "There are certain organic impurities that are harmless, but traces of iron, chlorine, nitric acid or arsenic are very injurious. The necessity of using chemically pure acid has been largely done away with by the greater purity of commercial acid." Mr. Walker stated that the battery companies supply their own electrolyte, which is very carefully tested; hence, in

his paper, he had emphasized the necessity of purity of water more than that of acid, because the former is more in the hands of the user.

Frederic Nicholls, vice-president Toronto Railway Company, extended an invitation to the members of the association to visit the new storage battery house just erected by his company. "Although it has been in operation only a very short time," said he, "its advantages have so demonstrated themselves that we are sorry we did not install a battery at an earlier date."

W. L. McFarlane was then called on to read his paper on "A. C. vs. D. C. Arc Systems."

Mr. McFarlane's paper, and the discussion on it, will appear in next month's Engineer.

On Wednesday evening two papers of exceptional merit were read, one on "The Curtis Steam Turbine," by Frank C. Smallpiece, and the other on "The Niagara Power Development," by K. L. Aitken. Both papers were illustrated with stereopticon views. Mr. Smallpiece and Mr. Aitken were warmly complimented on all sides for the research shown in their papers, and the admirable way in which they were presented. Summaries of these papers will be found elsewhere.

Thursday morning was spent by the convention in visiting points of interest in Hamilton. The party was carried by special cars to the Victoria Avenue sub-station of the Cataract Power Co., where the first stop was made. After allowing some time for the visitors to look over all parts of the plant, the party was taken to the new buildings of the Canadian Westinghouse Co., now in course of erection. Surprise and delight was expressed on all sides at the appearance of the buildings and surroundings. The feature that attracted most attention was the extensive, and in fact almost exclusive use of cement in construction. From the Westinghouse grounds the party was carried to the Deering works, the plant of the International Harvester Co. Here the convention party wandered at will over the extensive grounds and became quite scattered, some going to the sub-station, where the company receives its power direct from DeCew Falls, and some investigating the machine shops or pattern shops or moulding rooms, or other departments of the institution, that will, it is said, employ 3,000 hands when complete. There was some difficulty in getting the crowd together again, but the closing of the works for noon seemed to be effective in this regard, and the two cars were soon full and on their way back to headquarters at the Royal Hotel.

When the convention assembled on Thursday afternoon, Roderick J. Parke, E.E., was asked to read his paper on "Aluminum Wire as a Conductor," of which the following is a summary:

ALUMINUM ELECTRICAL CONDUCTORS.

By Roderick J. Parke, E.E.

Aluminum is so far the only material which possesses the requisite properties to render practical its substitution for copper. Since 1898, when it was first placed upon the market in solid drawn conductors, the consumption has rapidly increased until 1902, when the world's product was estimated at 8,000 tons per annum. The corresponding production of copper is estimated at 497,000 tons per annum, for all purposes. The statistics available up to the present, however, show that the production and consumption of aluminum is rapidly increasing and that it has become a very strong competitor of copper for electrical conductors.

There are now nine plants in the world producing aluminum, of which three are in America, two in France, and one each in Great Britain, Germany, Switzerland, and Austria. The total power utilized in the production of the aluminum is from 36,000 to 40,000-h.p., practically all water power.

The following figures are for commercial aluminum and commercial copper of sizes commonly used in practice, the copper being hard drawn:

	Aluminum.	Copper.
Specific gravity	2.[illegible]	[illegible]
Conductivity (Matthiessen standard)	62.	[illegible]
Tensile strength (per sq. inch)	28000	25[illegible]
Co-efficient of linear expansion (per F.)	.0000128	[illegible]
Co-efficient of temperature resistance	.00114	[illegible]
Modulus of elasticity	9,000,000	14,00[illegible]

(Commercial aluminum is 99.5 per cent. pure.)

From the above figures we deduce the following:

	Aluminum.	Copper.
Cross-section for equal resistance	1.5[illegible]	1
Diameter for equal resistance	1.25	1
Weight for equal resistance	.47	1
Tensile strength for equal resistance	.66	1
Price for equal cost	2.13	1
Rate of temperature change (resistance)	1.	1

We see at once that the principal difference, from an engineering standpoint, is that aluminum possesses less than half the weight of copper for equivalent resistance. This is a marked advantage and results in benefit in three ways: 1st. The cost of transportation of aluminum is less than that of copper. 2nd. The cost of erection of the aluminum is less. 3rd. The durability of the line is greater and cost of maintenace is less on account of the smaller strains to which poles, cross-arms, pins and insulators are subjected, (assuming equal spans).

An additional advantage of aluminum is that it retains for years, some of the grease used in drawing, and this grease prevents any great amount of sleet from forming upon it, thus avoiding one of the serious causes of interruption to service over pole lines. This result is rather surprising but the fact has been well established.

It does not follow that sleet will never gather on aluminum wire anywhere, because in the neighborhood of railroads and manufacturing plants, the wires are likely to become coated with smoke or some other foreign substance upon which the sleet will form. In general, however, it may be safely assumed that sleet does not form upon aluminum wires.

To balance the advantages cited there are the following disadvantages: 1st. Difficulty in making joints. 2nd. Greater sag, due to larger co-efficient of expansion. 3rd. Insufficient strength for conductors of the sizes used for telephone and telegraph wires.

JOINTS.

The difficulty of soldering aluminum is well known. This difficulty arises from three causes: First, because solder does not alloy with aluminum at a low temperature. It will alloy with copper at approximately 400 deg. F., but the alloying temperature with aluminum is about 200 deg. F. higher. Secondly, because of the high thermal conductivity of aluminum, the metal conveys the heat away very rapidly from the solder and the soldering iron, making it difficult to maintain a soldering temperature. And, thirdly, when aluminum is exposed to the air a thin invisible coating of oxide of aluminum instantly forms upon the surface, which must be removed to permit of the formation of an alloy between the solder and the clean metal. With other metals than aluminum, the oxide coating can be dissolved by means of soldering salts, but no such salt or flux has been discovered for aluminum, hence the difficulty in soldering it.

For joining aluminum wires smaller than No. 0000 B. & S. gauge, the two ends are inserted into a piece of flattened tube and the tube given two and one-half twists by means of two pairs of ordinary wire connectors. This makes a perfectly satisfactory joint of low resistance and as strong as the wire joined.

Larger sizes are conveniently joined in any of three ways. 1st. By means of the ordinary dovetail cable splice. (The Niagara Falls-Buffalo line, consisting of 500,000 c.m. aluminum cable, is joined in this way and has been in use three years with perfect satisfaction). 2nd. By means of terminals compressed on the ends of the cables at the factory, these terminals being threaded and thus adapted to be

united in the field by a threaded stud. 3rd. By inserting the ends to be joined into a cast sleeve and compressing the sleeves between dies in a small portable press.

Taps are made by means of aluminum clamps, one of which carries a lug into which the tap wire is either soldered or secured by set screws. Soldering into a lug is one of the pieces of aluminum soldering which can be readily accomplished.

It will be seen from the above that the difficulties of making aluminum joints have been reduced to an extent which leaves almost no disadvantage whatever.

SAG.

The sag of aluminum conductors is somewhat greater than that of copper in hot weather and on the ordinary spans, because the co-efficient of expansion of aluminum is 38 per cent. greater than that of copper. The sag is not as much greater, as might be expected, however, because the lower modulus of elasticity of aluminum causes it to contract more as the strain is relieved from it, and because the weight of aluminum, for equal areas, is only 3-10 that of copper, while the strength of it is 2-3 that of copper. This causes aluminum to start with a smaller minimum sag than copper.

One curious result of this is that whereas aluminum will have a maximum sag of three or four inches more than copper in a 100-foot span, it will have actually a smaller maximum sag in a 1,000-foot span, for while the span moves further, or deflects more rapidly, than copper, for a given temperature change, it starts with so much smaller sag at low temperature, that it never overhauls the copper, when long spans are used. On this account, and that of its small weight, it would seem to be the best material for long span work.

The writer has prepared a set of tables showing the tension of the various sizes of aluminum stranded conductors from 1,000,000 circular mills to No. 2 B. & S. gauge, when erected on standard spans ranging from 80 to 400 feet. These tables are based upon the table of tensions and deflections, prepared by the Pittsburg Reduction Company, and presented by Dr. F. A. C. Perrine and F. G. Baum, in a paper which these authors read before the American Institute of Electrical Engineers, at Philadelphia, May 18th, 1900. The deflections are calculated on the formula for the catenary, and the permissible tensions and corresponding deflections specified in these tables are based upon a maximum strain of 15,000 lbs. per sq. inch on the aluminum at 20 deg. below O.*

For 100 Ft. Spans
of
ALUMINUM STRANDED CONDUCTORS

T = Temp. of Atmosphere in Deg. F.
D = Deflection of Conductor in inches at Centre of Span.
The numbers represent the Dynamometer readings in lbs. of tension.

Gauge (B&S)	T=-20° D=⅛	T=-10° D=¾	T=0° D=10½	T=10° D=12½	T=20° D=14⅝	T=30° D=16	T=40° D=17⅝	T=50° D=19	T=60° D=20⅝	T=70° D=21½	T=80° D=22⅜	T=90° D=23⅝
1,000,000	11904	916	1352	1106	959	853	799	707	676	639	605	578
750,000	8929	437	1014	829	719	644	600	550	507	480	454	433
600,000	7142	45	811	664	575	515	480	425	406	384	363	347
500,000	5932	958	676	553	479	429	400	353	338	320	303	289
400,000	4762	767	541	442	383	343	321	283	270	256	242	231
0000	2523	405	287	234	203	182	169	150	143	136	126	122
000	2002	323	225	[illegible]	[illegible]	[illegible]	[illegible]	119	114	108	104	97
00	1594	276	[illegible]	46	26	[illegible]	107	94	90	85	81	77
0	1255	202	43	117	101	90	84	74	71	67	63	61
1	996	[illegible]	102	93	80	72	67	59	57	54	51	48
2	789	127	90	73	69	60	53	47	45	42	40	38

The use of a reliable dynamometer for stringing aluminum wire is strongly recommended, as it is a difficult matter to obtain linemen experienced in handling aluminum wire or who can be depended upon to provide that proper sags shall be set when stringing the wire. The use of the dynamometer does not involve any greater expense for the stringing of aluminum conductors than its non-use when stringing copper conductors, because the material can be handled much more easily and quickly than the copper can, size for size. The third objection for aluminum applies only to telegraph and telephone and similar work. The smallest size of aluminum, which it would be advisable to use in pole line work, is No. 4 B. & S. gauge, which has a breaking strength of about 1,000 lbs. which is the minimum strength that should be allowed in any conductor on a pole line, if uninterrupted service must be given over it. The principal uses of aluminum conductors have been for railway feeders, high tension transmissions and bus bars. Its use in Canada has not been very extensive, due to the fact that the beginning of its manufacture here is of rather recent date. But there are very few places in the United States where it is not found in service. Railway feeders have absorbed nearly two-thirds of what has so far been used. This use, presents no problems with which engineers are not familiar. For power transmission, its use has become very extensive. The longest and largest transmissions in the world are now made over aluminum. The following list and data may be of interest:

Locations.	No. Cables.	Miles per Cable.	C.M. Area of Each.
Niagara Falls to Buffalo....	3	20	500,000
Shawinigan Falls to Montreal	3	85	183,708
Electra to Mission San Jose	3	100	471,034
Colgate to Oakland	3	144	211,000
Farmington River to Hartford	3	11	336,420
Lewiston, Me.	3	3.5	144,688
Ludlow, Mass.	6	4.5	135,257

In addition to the foregoing list, the lines of the Telluride Power Transmission Company, in Utah, Colorado, and Montana, use nearly 2,000 miles of wire, involving transmission distances of 130 miles. The Cataract Power Co. has now 34 miles of aluminum.

For 200 Ft. Spans
of
ALUMINUM STRANDED CONDUCTORS

T = Temp. of Atmosphere in Deg. F.
D = Deflection of Conductor in inches at Centre of Span.
The numbers represent the Dynamometer readings in lbs. of tension.

Gauge (B&S)	T=-20° D=4⅝	T=-10° D=14⅛	T=0° D=20⅜	T=10° D=24⅞	T=20° D=28⅛	T=30° D=31⅛	T=40° D=35¼	T=50° D=38⅛	T=60° D=40½	T=70° D=43	T=80° D=45½	T=90° D=47⅜
1,000,000	11905	3869	2711	2211	1917	1776	1538	1948	1355	1281	1211	1155
750,000	8928	2902	2033	1658	1436	1332	1153	1086	1016	961	908	866
600,000	7143	2321	1627	1327	1150	1066	923	869	813	769	727	693
500,000	5953	1934	1355	1105	958	888	769	724	677	640	603	577
400,000	4762	1548	1084	884	767	710	615	579	542	512	484	462
0000	2523	820	576	469	401	376	326	307	287	272	252	245
000	2006	652	457	372	323	299	259	244	228	216	204	195
00	1592	417	362	296	256	237	206	194	181	171	162	154
0	1255	408	286	233	197	187	162	138	143	135	128	122
1	996	324	227	185	160	149	129	121	113	107	101	97
2	789	257	180	147	127	118	102	96	90	85	80	77

The question of the durability of aluminum conductors has frequently been raised, but so far aluminum has thoroughly established itself as a conductor offering no disadvantages which are not, in other respects, proportionately found in copper or iron. Aluminum is not readily oxidizable (the thin film spoken of above acting as a protecting coat, and preventing further oxidation). The greater number of mineral acids seem to have no chemical effect upon it, but chlorine in any of its unstable combinations is more or less detrimental to it, particularly where the conductors are exposed to sea air or where they are installed within the vicinity of certain chemical works. On the other hand, copper also is liable to be detrimentally affected by atmospheres laden with acid fumes. The most common impurity of aluminum is sodium which forms a very unstable alloy, readily attacked and corroded in even slightly moist atmospheres, but this defect can be provided against by the manufacturers. The tensile strength of any given aluminum conductor is increased somewhat by building it up of several smaller strands wound together, and since this form has been adopted, the writer has not learned of any instances in which conductors, properly installed, have broken on account of deficient tensile strength.

In connection with the installation of the electrical lighting power distribution system along the Welland Canal, now in progress, the Government purchased a quantity of alum-

* Two of these tables, those for 100 and 200 foot spans, will be found on this page.

inum and copper conductors for the transmission, distributing and telephone circuits.

The writer's specifications called for Nos. 0, 2, 4, 6, and 10, B. & S. copper conductors, the No. 6 B. & S. (for arc lights), to be medium hard drawn, and the No. 10 (for telephones), to be hard drawn. Tenders were also taken as alternative, for the supply of aluminum conductors of conductivities equivalent to those of copper conductors specified, and on comparing tenders it was found that the Nos. 3/0, 0, and 2, B. & S. aluminum conductors offered as equivalents for the Nos. 0, 2, and 4 copper, would cost less than the copper, and the aluminum was purchased. The aluminum equivalent for No. 6 copper, considering the tensile strength specified for the medium hard drawn copper, was found to be more expensive than the copper, consequently copper was purchased for the No. 6 and No. 10 gauges. The gauge numbers just mentioned for the aluminum conductors do not represent the correct relative proportions, as compared with copper, but are the nearest gauge numbers corresponding to the area of the aluminum conductors representing the copper equivalent.

The writer tested a proportion of the aluminum conductors for cross-section, tensile strength, torsion and resistance, and found the results given in the table below:

Approx. Gauge	No. of Strands	Approx. Gauge of Strands	Twists in 6 inches	Breaking Strains per sq. in.	Elongation in 6 per cent	Res. per 1,000 ft. at 75 F.
000	7	7 B & S.	21	29,100 lbs.	2	.106
0	7	9 "	22	33,000 "	2-2/3	.172
2	7	10 "	30	35,500 "	3-1/3	.262

These results seem to show that the tensile strength increases somewhat with a reduction in area of the smaller strands composing the conductor.

Also it will be seen that the conductivity of the aluminum conductors, as compared with that of pure copper conductors of the equivalent smaller gauges specified, is approximately 99.3, 98.5, and 99 per cent., respectively, and the respective breaking strains of the aluminum, per square inch, exceed the breaking strain usually allowed for soft copper (pure), namely, 23,000 lbs.

The questions are often asked, with relation to alternating current work, as to the respective capacity, self-induction and skin effects of aluminum and copper.

As aluminum is 1/4 greater in diameter than equivalent copper, it is evident that the self-induction of the line will be the same when the aluminum wires are separated 25 per cent. more than the copper wires. The static capacity of the aluminum will be approximately 5 per cent. greater than that of copper, with the same spacing. The skin effect will be exactly the same with either of the two metals, since the effect of the greater diameter of the aluminum is exactly offset by its greater specific resistance, in making the calculations for the per cent. increase of resistance.

All practical transmission lines possess sufficient excess of self-induction over capacity to cause a slight lag in alternating currents, and the power factor over an aluminum line would therefore be slightly better than that over a copper line, on account of the smaller self-induction and greater capacity. The difference is small, but what there is, it is in favor of aluminum.

The market prices of aluminum and copper have always been such, for the past five years, that from 5 to 15 per cent. can be saved by the purchase of aluminum. For instance, the present market price of copper is about 14c. An equivalent price of aluminum would be 29.8c., whereas aluminum can be had to-day for 27.5c., or the equivalent of 13c. copper.

At the close of his paper, Mr. Parke read an extract from a paper by L. B. Stilwell, which stated that in the Niagara Falls-Buffalo transmission line, 500,000 c.m. aluminum and 350,000 c.m. copper cables are used, and that during a high windstorm the vibration on the pole of the copper circuit could be felt from the ground up, while on the aluminum line there was no vibration. Aluminum, says Mr. Stilwell, seems to keep a constant position relative to the wind, whereas copper introduces stresses and strains on the line.

Mr. Lincoln criticized Mr. Parke's tables of sag, as being merely theoret[illegible] temperature [illegible] wire, consequently [illegible] table[illegible] tice. He had been to[illegible] an aluminum conduct[illegible] appear. He did not [illegible] and would be an ob[illegible] regard to Mr. Stilwell's remark, [illegible] line was equipped with six wires, [illegible] carried three, making the [illegible] times that on the latter.

Mr. Parke explained that the Pittsburg Reduction C[illegible] made some experiments two or three years [illegible] a formula from which they calculated [illegible] 1900 Transactions of the American Institute [illegible] Dr. Perrine's paper, you will find table No. 2, which [illegible] partly observed by the Pittsburg Reduction C[illegible] a theoretical table and also a practical table and [illegible] results agreed very closely." Mr. Parke me[illegible] point, namely, that in tying aluminum wire it is essential that a soft aluminum wire should be used, not larger than No. [illegible] In making connections to an aluminum wire, the use of copper or any other metal should be avoided, as aluminum is highly electro-positive in regard to all the other common metals. The aluminum is rapidly corroded, except where the copper is well soldered in and covered with rubber.

George Johnson's paper on Statistics of Electrical Progress in Canada was taken as read. Mr. Johnson's paper will be published in the Engineer next month.

P. M. Lincoln was then called on for his paper on "Heavy Electric Traction," the substance of which was as follows:

HEAVY ELECTRIC TRACTION BY ALTERNATING CURRENTS.

By P. M. Lincoln.

Again and again the prophecy has been made that electricity will take the place of the steam locomotive in the [illegible] service in trunk lines just as it has replaced the horse as a motive power for local service on urban and suburban lines. The writer recently looked up the records of one of the large electric manufacturing companies to find the extent in which electricity has been substituted for steam. He [illegible] the B. & O. tunnel, in Baltimore, the New York elevated lines and the proposed electrification of Pennsylvania and New York Central systems in and around New York. He expected to find many other examples where electricity had displaced steam. It was surprising to find that these examples were practically the only ones where such substitution has been made or actively undertaken in the United States. Even in the cases cited, the change from steam to electricity can hardly be said to have been made voluntarily. The New York Central decided to make the change only after an appalling accident, due to the obscuring of signals by the smoke of locomotives. In the case of the Pennsylvania Railroad the use of long tunnels, which would be [illegible] by locomotive smoke and gases, forced the adoption of electricity. In the case of the Baltimore tunnel, it required an [illegible] the courts before the change to electricity was made.

There seem to be two reasons for this lack of progress in displacing the steam locomotive, one a technical and the other a psychological reason.

First, till recently the only thing that the electrical engineer had to offer for trunk line operation was the direct current motor with a maximum voltage of, say, 700, and the necessary rotary converter equipment. In spite of the objections to this system, there has been no time within the last five years when the electric companies would not have undertaken to equip any trunk line and guarantee to render at least the same service as is rendered by steam. As to relative cost, there comes in the question of the character and density of the traffic. In many instances, the trunk line traffic could be done more cheaply by electricity even when the D. C. system was used. With heavy trains at long inter-

vals, the handicap against electric traction increased until the point where practically no saving could be shown. The advent of the alternating current motor changed all this.

As to the psychological reason, the author says the electrical engineer must not only develop a system capable of handling the traffic of a trunk line, but he must convince the trunk line managers that he can handle their traffic. It is not the trunk lines that are putting in the many high-speed and heavy service electric roads, but a new type transportation engineer not bound by the traditions of the steam railroads.

It is appreciated that there is reason why the trunk lines should hesitate to adopt at once so radical a change as that of electricity as a motive power. The steam locomotive is doing its work and doing it well. Electricity, therefore, is not a necessity, the manager reasons, only an improvement—and of that proposition he is by no means convinced, and apparently does not desire to be convinced. Briefly, the question is: Can trunk line traffic be handled economically by electricity? Since the advent of the single phase A. C. motor our answer is an emphatic yes.

The advantages of the alternating over the direct current systems are apparent. Those which pertain particularly to heavy traffic are:

1st—Elimination of the trolley voltage limit resulting in: (a) Reduction of the current to be collected by use of higher trolley voltages. (b) Ability to use overhead contact conductors rather than third rail. (c) Increased economy both in copper and power.

2nd—Elimination of the rotary converter.

It is in the elimination of the trolley voltage limit set by the maximum allowable voltage that can be put on a D. C. motor that the principal advantage accrues to the A. C. system. To do the work now done by the steam locomotive requires enormous power. To get this power at even maximum voltages allowable in D. C. work involves currents from 4,000 to 8,000 amperes for a single train. The delivery of this power from sub-station to train means both expensive conductors and large losses. But the expense and the loss are perhaps not the greatest problems. These currents must be taken into the trains through a moving contact. This in turn demands a working conductor with a large surface, and is a problem that demands the most careful consideration. The usual solution is the third rail. This furnishes a working conductor with both a large surface and large current carrying capacity. But the expediency of equipping trunk line railway systems with third rail is, to say the least, doubtful. An overhead conductor is preferable for many reasons. Raising the voltage of the working conductor cuts this Gordian knot at once. For trunk lines a trolley voltage of 3,000 might be a minimum, and 10,000 volts would be proposed without hesitation. This latter voltage has been successfully used abroad under circumstances much more trying than would obtain with a single phase system, in that all three conductors of a three-phase system with 10,000 volts between any two were used as working conductors. In the single phase system only a single overhead conductor need be used.

Since the cost of conductors to take power from substation to train is the greatest single item in the D. C. system, this raising of the trolley voltage is a large factor in cutting down the cost of the A. C. relative to the D. C. system.

The elimination of the rotary converter is probably the difference next in importance. Not only does the use of alternating current eliminate a large element of first cost, and an element of loss averaging probably 10 per cent., but by making available higher trolley voltages, it also makes the number of sub-stations smaller and eliminates the necessity of skilled attendance at the sub-stations that are used.

Considering electrically-driven trunk line traffic, we have two problems to discuss:

1st—Electricity vs. steam, and

2nd—Direct current vs. alternating current.

As to the latter question, there is no doubt. As to the first, the following points of advantage in electric drive may be offered:

1st—Reduced Weight of Locomotives—Forty-five per cent. of the weight of a steam locomotive and tender is about the average available for traction. In the electric locomotive every pound is available for traction. The weight of an electric locomotive, so far as tractive effort is concerned, may be cut down to at least half that required by steam, and as the weight of locomotive and tender constitutes 5 to 25 per cent. the weight of the train, electric traction can save from 2½ to 12½ per cent. of the power required under steam service. In other words, considering tractive effort alone, the live freight per train may be increased 2½ to 12½ per cent. with electric drive.

2nd—Uniform Torque.—Another condition that will serve to enhance the difference in weight is the uneven torque exerted by the steam locomotive within a single revolution of the drivers, as compared with the perfectly even torque exerted by the electric locomotives. A given weight on drivers is therefore more effective in the electric than in the steam locomotive.

3rd—Perfectly Balanced Drivers.—In this respect the electric locomotive is decidedly superior to the steam locomotive, where a perfect balance is an impossibility. At high speeds, therefore, the pounding of the steam locomotive on the track, one of the greatest elements in the deterioration of the permanent way, is entirely avoided by the use of electric drive.

4th—Fewer Repairs.—Electric railway motors have been known to make a mileage of as much as 450,000, requiring renewal of bearings only. Such a record with a steam engine and boiler under such conditions is unthinkable, as well as unreasonable to expect in view of the greater number of parts and the reciprocating motion. On account of this greater sturdiness of the electric locomotive, it follows that to render a given service fewer electric than steam locomotives will be required, because the proportionate number in the round-house will not be so great. The result is not only a smaller repair bill but also a smaller number of machines to provide, house and care for.

5th—Utilization of Water Power.—The use of electric traction gives an opportunity for the utilization of water power that is impossible with steam. This is of particular interest to Canadians, because of the scarcity of coal and the abundance of water power. This same consideration has caused the Swedish Government to determine to change all the railroads of Sweden from steam to electric drive, and the first active steps looking toward this change have already been taken.

6th—Multiple Control.—The electric drive lends itself easily to distant control. It is possible to subdivide the drive into relatively small units and place them at intervals through the train, still retaining control over the individual units at a central point. This avoids the necessity of concentration of weight at the front of the train, as well as the excessive draw-bar pulls, both of which problems are of no small dimensions in steam practice.

7th—Smoke and Cinders.—The abolition of the smoke and cinders of steam locomotives, though it does not add to the economy of the electric system, still is an advantage vastly appreciated by the travelling public.

8th—Economy.—All the points above mentioned are in the direction of increased economy. In addition, however, we have in case steam power is used, the vast difference between the economy that can be obtained from relatively large stationary engines operated with condensers on the one hand, as against the locomotive on the other, which must run non-condensing and in which the losses by radiation, relatively small grate area and changes in load are severe. The question of relative economy between steam and electric motive power on trunk lines was considered by Mr. A. H. Armstrong, in a paper read before the Canadian Society of Civil Engineers, November 19th, 1903. From his analysis and conclusions, it is safe to assert that nine-tenths of the trunk line traffic on this continent can be operated more economically by electricity than by steam. This showing is made, too, on the basis of using steam generated power. The showing is bound to be much better where water power is available, as is the case throughout the whole of Canada.

In reply to various questions, Mr. Lincoln gave the following additional information:

A single-phase system requires only two conductors, one of which may be the rail. With polyphase it is necessary to have at least two conductors beside the rail. The frequency first proposed was 16 2-3 cycles per second, but that has since been changed to 25, the standard for power purposes now. The motor is practically a D.C. motor—a series motor with laminated field, so designed as to work on A.C. If you raise your frequency, it still operates, but the power factor becomes lower. If the frequency is raised too far, sparking will be produced at the commutator. The maximum voltage at the motor is about 150, or for steam railway practice, as high as 500. The trolley voltage is limited only by the line insulation. The air-gap is very nearly the same as that in an equivalent D.C. motor—about ⅛ in a 100-h.p. motor. One feature in the A.C. motor, tends to limit bearing wear. If the armature gets out of centre, local currents are set up to make the magnetic side-pull practically nil.

An A.C. motor is also a D.C. motor, but it is not good practice to make the equipment so that it will operate on both. The capacity of a motor is greater as a D.C. motor.

Any method of regulating voltage will regulate speed. The rheostat method may be used as well as a number of other methods, such as bringing loops out of the transformer and attaching the motor to different loops. "We propose putting on each car an induction regulator connected between the motors and the transformer, so that by moving the primary of the regulator through an arc of 180 deg., its voltage may be added to or taken from the transformer."

This motor is just the type for work that demands a variable speed motor.

The single-phase system has not yet been put into actual service, except on what may be called an experimental line in East Pittsburg. The high voltage trolley is coming, but I do not think it wise to jump from 500 volts to 10,000 volts. I would recommend 1,000 or 2,000 volts at present. But on heavy railway lines higher voltage should be used. The trolley voltage for practically all the lines we have sold is 1,000 volts. Step-down stations are provided on the line at intervals of five or seven miles. There is no feeder on the lines, nothing but the trolley. One of these lines is at Indianapolis and Cincinnati, 53 miles. Another is the Fort Wayne and Springfield, Ind., 21 miles. Others are at San Francisco, Philadelphia, Atlanta, Cheboygan, Wis., and Jamestown, N.Y. None is less than 20 miles long. The first will be in operation this fall.

There will be no attendants at the sub-stations, as all apparatus will be automatic. The trolley is one that cannot get off the wire. The system, as a whole, costs at least 15 per cent. less than a D.C. system.

An invitation for next year's convention was received from Peterboro, but as it was thought better that the Association should go east, it was decided to hold the convention in Montreal.

The election of officers resulted as follows: K. B. Thornton, Montreal, president; A. A. Wright, M.P., Renfrew, 1st vice-president; R. G. Black, Toronto, 2nd vice-president; C. H. Mortimer, Toronto, sec.-treas. Executive Committee, A. B. Smith, A. A. Dion, G. Henderson, B. F. Reesor, J. A. Kammerer, A. E. Evans, C. B. Hunt, John Murphy, Fred. Thompson, J. J. Wright.

C. B. Hunt reported for the Legislative Committee that no fighting had been necessary during the past year, but that it would still be necessary to watch the existing law which will sooner or later be attacked by a growing agitation for municipal ownership. It behooves existing companies to deal generously with the public and educate them to understand that electric light companies are not veritable gold mines, or otherwise robbers, which some agitators would lead them to believe.

The business sessions of the convention then adjourned.

In the evening the annual banquet was held.

Friday morning the convention was carried by special car on the Grand Trunk to St. Catharines, whence buses and carriages were provided to cover the four miles to the DeCew power-house. After spending a couple of hours in investigating the power house, penstocks, etc., and in doing justice to the ample luncheon provided by the Company, the party returned to the railway station and from there went by G.T.R. to Niagara Falls. The members then scattered over the ground occupied by the various power companies. The C.E.A. button was in evidence everywhere, and groups of men could be seen here and there earnestly discussing their surroundings, only to be interrupted by the sudden appearance of a construction train, or the unexpected movement of a derrick. The scattered electricians re-assembled, however, in time for the five o'clock train to Hamilton, and with the return of the party to that city, the convention was over.

(Note.—The DeCew Falls and the Niagara Falls developments were described in the June number of the Canadian Engineer.)

THE CURTIS STEAM TURBINE.*

By Frank C. Smallpiece.

The author, after sketching the early applications of the turbine principle, stated that the first announcement regarding the Curtis Steam Turbine was made in April, 1903. The design of this turbine is based upon the ideas of Chas. G. Curtis, of New York, which are the subjects of patents granted in 1896. Subsequently, machines of this type were built and tested at the Schenectady Works of the General Electric Company. The results of these extended investigations were so favorable that arrangements were made for the manufacture of the turbine.

Before undertaking commercial production, however, considerable time was spent in further development, under the direction of W. L. R. Emmet, of the General Electric Company. A number of features of the present machine were added during this period, the most important being the adoption of the vertical type of machine. Experience has demonstrated the reliability of the vertical turbine and all turbo-generator sets of 500 K.W. and upwards are now constructed in this form.

About a year ago the first Curtis turbine set built by the General Electric Co. for use outside its factories, was put into operation at Newport, R.I. Since its installation, two other machines have been placed in the same station. These turbines have carried the whole load of the station without interruption since installation. In Chicago, there have been installed three 5,000 K.W. units, two of which have been in regular service for some months. At the present time there are in regular operation Curtis turbines, aggregating 32,000 K.W. capacity in 28 units of 500 K.W. and upwards.

The action of the steam turbine involves the conversion of the heat energy of the steam into velocity by expansion. This rapidly moving steam is directed into buckets or vanes arranged upon the periphery of the revolving element where the kinetic energy of its particles is given up by impact. In its elementary form the steam turbine consists of one or more steam jets impinging upon the vanes of a single wheel, but the spouting velocity of steam is so enormous, that for most efficient action such an arrangement requires a wheel velocity much in excess of the safe working limit of the best materials. Further, unless a wheel of excessive diameter be employed, it is necessary to use gearing to reduce the speed for practical purposes. For this reason the efforts of inventors have been towards the design of a turbine which shall combine high efficiency with a speed permitting direct connection for electrical or marine purposes. In all turbines the expansion which takes place is so rapid that it necessarily follows the adiabatic line. The steam is directed upon the revolving buckets, either through stationary vanes, similar to the revolving buckets in form, but reversed in curvature, or by expanding nozzles which efficiently convert the energy of the expanding steam into velocity. In the latter case the conversion of the inherent energy of the steam into kinetic energy is carried out in the nozzle to any desired limit.

---

* From a paper read before the Canadian Electrical Association.

Referring to Fig. 1, we have a sectional view of the expanding nozzle, such as is used in the Curtis Steam Turbine. Steam is admitted from the space above and converges towards the narrowest section known as the throat. At this point its pressure has fallen to .58 of the initial pressure and a corresponding portion of the heat energy of the steam has become active in expansion, thus performing work upon itself in giving velocity to its own particles. Beyond the throat, if it is desired to increase the velocity still further, the same energy transformation continues. To allow further expansion, however, it is necessary to increase the cross sectional area of the nozzle. This is evident when we consider that the work done by the expanding steam varies approximately in direct proportion to the number of expansions and also as the square of velocity. Hence the volume of the steam increases much more rapidly than the velocity, and it is necessary to provide for this increased velocity by enlarging the section of the stream.

It is difficult to appreciate the completeness of this energy transformation. Assume the case of a nozzle used to expand steam from 150 lbs. gauge pressure to an absolute pressure of 2 inches of mercury, or 28 inches vacuum. Entering the nozzle the steam is at 150 lbs. pressure, and its energy exists in the potential form. At exit from the nozzle, a few inches distant, the pressure has fallen to 28 inches vacuum, and the specific volume of the steam has increased some 125 fold. The same energy (neglecting slight friction losses), exists in the particles of steam which issue from the nozzle at about 4,000 feet per second. The energy of a moving body being proportional to the square of its velocity, one pound of steam under these conditions represents 250,000 foot lbs. of energy.

The writer then briefly described other leading commercial types of turbines, namely, the De Laval, the Parsons, the Rateau, and the Reidler-Stumpf, most of which were described in Prof. Jacquays' article in The Canadian Engineer for December, 1903.

The great advantage of the Curtis Steam Turbine, as compared with other types, is the low speed of rotation which it is possible to obtain without sacrifice of efficiency. In its present construction the expansion takes place in several stages or separate compartments, each stage being furnished on the admission side with suitable nozzles which direct the steam into the bucket wheels in that stage. In each stage are arranged bucket wheels carrying two or more rows of buckets, while between successive rows of moving buckets are the intermediates or stationary buckets reversed in direction. The steam from the nozzle strikes the first row of moving buckets, giving up some of its energy, shown in loss of velocity. Leaving the moving buckets, the steam is guided through the stationary vanes and impinges upon the second row of moving buckets, giving up another portion of its energy. Should there be more than two rows of buckets the same course is followed, rebounding from stationary to moving buckets, until almost brought to rest on leaving the last wheel. This process is known as fractional abstraction, and in this way high velocity steam is made to efficiently impart motion to a comparatively slowly moving element.

The arrangement of nozzles in the Curtis Turbine is clearly shown in Fig. No. 1. Instead of a number of separate streams, the flow is directed in a belt upon the buckets. The nozzles occupy only a small part of the circumference in the first stage, the breadth of the steam belt increasing in succeeding stages. In the last stage, where the volume of steam is very large, steam is generally admitted all round the wheels. As the steam admitted to the turbine is directed upon only a portion of the circumference, it is possible to obtain any desired speed of rotation within wide limits by using a wheel of suitable diameter. This is an advantage not presented by turbines in which steam is admitted all round the wheels.

Governing is accomplished without loss of pressure by throttling. The admission of steam to the sections of the first stage nozzles is controlled by separate valves, which operate consecutively. With a change of load the breadth of the active steam belt is varied automatically by the closing of one or more of the end sections. In this way the supply of steam is not dependent upon action of a single valve, and a failure of one of the sectional valves only serves to throw the work upon the next in order. In some of the first machines, this sectional governing was carried out simultaneously in all stages. However, as the economy is not materially improved by this arrangement, it is not employed. Hand operated valves, opening additional nozzles, are sometimes employed in the latter stages. These are set to give the best possible conditions under the average of load of the machine, but are not adjusted for fluctuations of short duration. For overload conditions automatic valves are occasionally used to limit the rise of pressure by opening additional nozzle sections in the next lower stage.

The governor itself is of the centrifugal type and is attached to the top of the generator shaft. The motion of the governor, by electrical or mechanical means, is made to operate small pilot valves, which in turn admit or exhaust live steam from the spaces behind the governing valves. In the case of electrically operated valves the governor actuates the fingers of a small controller, opening or closing the circuits of electro magnets, which in turn operate the pilot valves. The current for these magnets is taken from the exciter bus-bars, and the arrangement is such that, in case of failure of the current supply, the governing valves close, avoiding the possibility of a dangerous increase in speed. When the electrical control is not employed the pilot valves are actuated directly from a suitable cam cylinder, which is turned by the governor. For synchronizing purposes a device is used in conjunction with the governor whereby the speed of the turbine can be varied considerably while the machine is in operation. In large machines this synchronizing device is operated by a small motor, controlled from the switchboard.

As an additional safeguard against possible racing of the turbine, simple emergency tripping devices are arranged which act at a speed somewhat in excess of normal, and close a butterfly valve in the main steam pipe. At the same time a valve in the lower part of the machine is operated and breaks the vacuum.

A distinctive feature of the Curtis Turbine, as compared with other types, is its vertical form. The saving in weight and floor space is very considerable, the weight being from 15 to 25 per cent. and the floor space less than 10 per cent. that of a slow speed engine generator set of the same capacity. Fig. No. 2 shows a comparative view of a 500 K.W. 100 R.P.M. Hamilton Corliss Cross Compound Engine with generator and a 500 K.W. 1,800 R.P.M. Curtis Turbo-Generator unit. The engine unit occupies 750 square feet and weighs 277,000 lbs., as compared with 50 square feet and 38,000 lbs. for the turbine set. The adoption of the vertical form of machine called forth considerable criticism, but the satisfactory results obtained have exceeded the expectation of the designers. The step bearing consists of two cast iron plates, one of which is keyed to the foot of the shaft, the lower plate being stationary. Oil under pressure enters a central recess in the faces of the plates and is forced outwards to the circumference. Thus the whole weight of the moving element is carried upon a thin film of oil. The upper bearings serve only as guides for the shaft, and are not subjected to any load. The mechanical friction of this arrangement is almost nil. With the vertical type of machine there are none of the difficulties in vibration met with in the supporting of a heavy rotating element between horizontal bearings at a considerable distance apart. There is less tendency of the shaft to spring and cause rubbing, and as the whole weight is carried by the step bearing, the diameter of the shaft need not be reduced at the journals but may be made as large as desired. The compact arrangement of the wheels and casing makes the expansion very small, and furthermore, all expansion is upward and does not produce the distortion encountered in horizontal machines.

In a station comprising a number of vertical units, the oil is supplied from one or two steam-driven pumps, and as a precaution against failure, a dead weight accumulator may be employed, capable of supplying high pressure oil for a limited period. The worst that can happen in case of failure of the oil pressure is a grinding of the step bearing plates. These can either be faced off or easily and cheaply replaced

by new blocks. When the forced supply of lubricant to a horizontal machine fails, it usually results in cutting the shaft as well as the bearing.

It is of interest to note that in the Curtis Turbine there is no end thrust due to the action of the steam on the buckets. The angles of entrance and of exit being the same in a moving bucket, the components of the force, exerted in a direction parallel to the shaft, are equal and opposite in sign. The pressure of the medium in any stage is the same at all points. The absence of end thrust is demonstrated in that there is no rise in the oil pressure on the step bearing of the machine when steam is turned on.

A very high degree of expansion is desirable, though not essential, for favorable results in the Curtis Turbine. Owing to the compact arrangement of the casing, the chances of air leakage are extremely small, and a high vacuum is easily maintained where a liberal supply of condensing water is available.

In general, the surface condenser is preferable for use with steam turbines. This type permits a higher vacuum and also allows the return of the condensed steam to the boiler. No oil comes in contact with the steam during its passage through the turbine. Consequently, the exhaust steam is free from impurities.

When the amount of cooling water is limited, the jet condenser may be found advisable, but the vacuum attainable with this type of condenser is not so good on account of the presence of entrained air in the injection water.

As to whether the somewhat higher initial cost warrants the installation of surface condensers is a matter to be decided by local conditions. The price of coal, the load factor, temperature and quantity of cooling water available, and other considerations may make it advisable to provide for a 27-inch vacuum or even a 26-inch vacuum in place of a 28-inch vacuum or higher. Nevertheless, in most cases the gain in economy, due to high vacuum, warrants the expense entailed. Accordingly, stations equipped with Curtis Turbines are almost, without exception, provided with condensing plants to secure a vacuum of at least 28 inches.

Machines known as the Condenser Base Turbines form a new type. Several of these are under construction, the condenser being contained in the turbine base. The simplicity of this arrangement, the short direct path of the steam to the condenser, and the saving in floor space are at once evident. Figure No. 3 shows a 2,000 K.W. set of this type.

The losses due to friction and windage in the Curtis Turbine remain in the form of heat, and are thus largely useful in re-evaporating the water of expansion. Drier steam is in this way supplied to the next stage. Unlike the reciprocating engine, the accidental carrying over of water from the boilers produces no ill effects in the turbine.

Superheated steam up to any temperature commercially available, may be used in the standard Curtis Turbines, the design of the apparatus allowing either dry or superheated steam to be used at will.

A limited series of tests indicates that in the Curtis Turbine the use of superheat decreases the steam consumption at the rate of about 1 per cent. for every 14 degrees F. Similar considerations as affect the choice of vacuum apply largely in the case of superheaters. The initial cost and maintenance, and cost of fuel have to be considered. Recent experiments indicate that at high temperatures the specific heat of superheated steam at constant pressure is considerably in excess of the value heretofore assumed (viz., .48). Hence the reduction in water rate due to highly superheated steam may be gained at the expense of too much fuel. However, as a general rule, a moderate amount of superheat is advisable.

It will be readily understood that the problem of generator design for steam turbines involves a great many features not encountered heretofore. The construction of the revolving element must be of great strength and rigidity. All parts must be balanced separately with the greatest care. In the case of revolving field machines, the field core is built up of steel plates rivetted together in sections of one-half to one inch thick, depending on the size. Each of these sections must be balanced accurately before assembling. The edgewise wo[illegible] fi[illegible] in baking, and re[illegible] impossible. The [illegible] running conditions. [illegible] by the addition of [illegible] employed in the balancing [illegible] commutator, armature heads [illegible] ately and the punchings [illegible]

Data regarding the performance of Curtis Turbines up to the present been largely confined to results [illegible] in the factory, and few opportunities for official tests [illegible] been presented. The tests given [illegible] were made [illegible] 500 K.W., 60 Cycle, 2,300 V. [illegible] R.P.M., and installed in the Newport Station of the [illegible]sachusetts Electric Company. Current from this station [illegible] supplied for railway and lighting, the railway work being the most important part of the load. The tests were conducted by George H. Barrus, consulting engineer, representing the owners, and R. H. Rice, recently of Rice, Sargent & Company, and A. R. Dodge, acting for the General Electric Company.

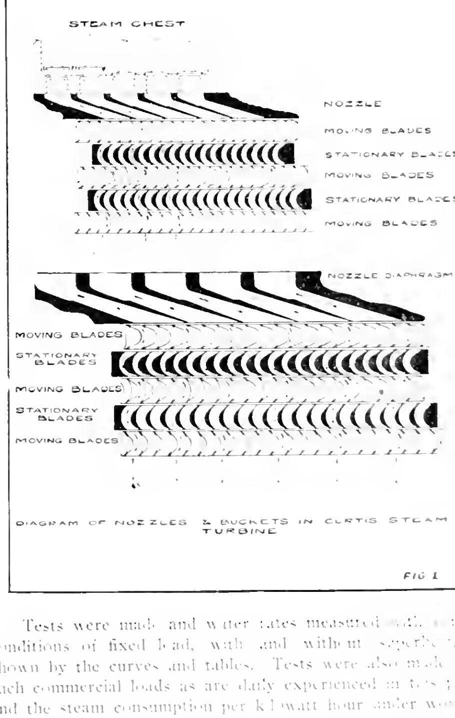


DIAGRAM OF NOZZLES & BUCKETS IN CURTIS STEAM TURBINE

FIG 1

Tests were made and water rates measured [illegible] conditions of fixed load, with and without superheat [illegible] shown by the curves and tables. Tests were also made [illegible] such commercial loads as are daily experienced in [illegible] and the steam consumption per kilowatt hour under working conditions was ascertained by careful determinations of the total water condensed, and of the load as measured by [illegible] instruments and as recorded by carefully checked re[illegible] wattmeters.

Attention is specially called to the records of [illegible] under commercial load, since they illustrate the great [illegible]tical advantage afforded by apparatus of this kind. [illegible] during these tests fluctuated incessantly with an [illegible] sudden variation of about 100 kilowatts, and with an average load of 253 kilowatts in one case and 421 kilowatts in [illegible]. In the former case the average steam consumption [illegible] kilowatt hour was only 22.38 lbs. The best steam [illegible] used for such purposes in this country would consume at least 28 pounds of steam per kilowatt hour under such load conditions, and in most cases the consumption would be considerably larger. The consumption of 20.73 pounds per kilowatt hour with an average of 421 kilowatts for such variable load is also a very fine performance. During tests the steam pressure was about 145 pounds and the vacuum about 95 per cent. The speed regulation from no load to

full load was 8-10 of 1 per cent. Momentum speed variations at full load did not exceed 1.6 per cent., and under the commercial load of the station showed a maximum of 2.1 per cent.

The liberal design of the generator is shown in the temperatures. After a run of eight hours at 660 K.W., the highest temperature rise was 38 degrees C.. and with a load of 764 K.W., or 53 per cent. overload for two hours, no further increase in temperature was noted.

In considering these practical results, it should be borne in mind that the plant which gives these results possesses many other practical advantages which conduce to economy. All the condensed water in this plant since it originally started has been returned directly to the boilers, and the boilers are consequently at the present time in a perfectly clean condition, although the natural water supply of Newport is bad. During all this time no oil has passed into the boilers nor has any been wasted. All the oil in use is simply circulated and used over and over again. The absence of air leakage in the turbine and the absence of air in the feed water greatly simplify the maintenance of good vacuum. which, of course, contributes to these excellent, practical results. The whole arrangement of this plant is compact, simple and easy of maintenance, and the results are representative of those which can be obtained anywhere from such apparatus where the water for condensation is available.

SUMMARY OF COMMERCIAL RUNS.

	Jan. 15, 1904.	Jan. 26, 1904.
Duration	12 hours.	15 hours.
Total coal wet	13,517 lbs.	10,205 lbs.
Moisture in coal	3.1 per cent.	5.5 per cent.
Water evaporated	127,267 lbs.	104,026 lbs.
Drip withdrawn from steam pipe per hour	......	46 lbs.
Moisture by calorimeter	3.05 per cent.	2.1 per cent.
Total steam to turbine	108,100 lbs.	86,833 lbs.
Steam per hour to turbine	9,008.6 lbs.	5,789 lbs.
Dry steam per hour to turbine	8,733.8 lbs.	5,667 lbs.
Load by polyphase meter	406.4 kw.	234.7 kw.
Load on auxiliaries (average)	14.9 kw.	18.5 kw.
Total load average	421.3 kw.	253.2 kw.
Dry steam per kilowatt hour	20.73 lbs.	22.38 lbs.
Dry coal per kilowatt hour	2.67 lbs.	2.54 lbs.

Load	1½	Full	¾	½	¼
Dry steam per kilowatt hours, lbs.	20.22	19.78	20.69	21.38	27.85

The above results were obtained on the first commercial machine, and changes have since been made which greatly improve the economy. From incomplete tests upon a new 2,000 K.W. set, it would seem that the results obtained on the first machine can be improved by at least 15 per cent. Complete figures on these tests are not available at present.

RECENT INCORPORATIONS.

Henry F. Gooderham, and others, have been incorporated as The Canadian Iron Co., Limited, with a capital of $2,000,000, to carry on mining, milling, reduction and development. The head office is at Ottawa. The provisional directors are: H. F. Gooderham, H. N. Barry, and R. Weir.

The Star Chrome Mining Co., Limited, has been incorporated at Montreal, with a capital of $450,000. Those incorporated are: F. Bayard, P. E. Beaudry, J. A. Brossard, P. Desforges and E. E. Gauthier, all of Montreal.

The Rio de Janeiro Light and Power Co., Limited, was recently incorporated at Toronto, with a capital of $25,000,000. The incorporators are: J. S. Lovell, W. Bain, R. Gowans, E. W. McNeill, M. Lash, and others.

W. M. Campbell, G. T. Merwin, and others, have been incorporated as the International Gas Appliance Co., Limited, with a capital of $49,000. Head office to be Toronto.

The B. C. Gazette announces the incorporation of the Chilliwack Power and Light Co., Limited, with capital of $500,000.

The following incorporations are announced in the Ontario Gazette:

The Richter Manufacturing Co., Limited, has been incorporated to manufacture and deal in burlaps, canvases, and other fabrics for interior decoration. The provisional directors are: P. C. J. Richter and F. H. Lancaster, of New Jersey, and R. W. Menzie, J. McK. Murray and R. E. Menzie, of Toronto. Capital, $50,000.

The Alvinston Power Co., Limited, to carry on business of an electric light company in all its branches. The provisional directors are: R. McLaughlin, A. S. Harkness, D. C. Munro, L. I. Hunt and T. A. G. Gordon. Capital, $40,000.

The Ronan Motor Co., Limited, has been incorporated in Toronto, with a capital of $100,000, to manufacture engines, motors, vehicles, etc. The directors are: J. S. Lovell, Wm. Bain, R. Gowans, E. M. McNeill, R. Richardson, M. Lash and W. Gow.

The Dominion Brass Works, Limited, has been incorporated in Port Colborne to manufacture and deal in all kinds of brass goods and hardware, and to acquire the Canadian patents for the manufacture of the Huxley Valve. Provisional directors: W. R. P. Parker, E. H. Bickford and W. A. Hare. Capital, $100,000.

The Canadian Adjustable Bearing Co., Limited, with a capital of $100,000, has been incorporated. The head office is to be at Windsor, and the provisional directors are: J. F. Harrigan, A. W. Atterbury, I. W. Durfee, F. H. McPherson, and A. F. Falls.

The Sovereign Oil Co., Limited, has been incorporated, with read office at Combe, Ont. The directors are: J. C. Winters, Wm. McIntosh and J. A. McIntosh. Capital, $50,000.

The following changes are announced by the Ontario Gazette:

The capital stock of the Elginfield Oil and Gas Developing Co., of Dutton, Limited, has been increased from $49,000 to $200,000.

The Guelph Axle Manufacturing Co., Limited, has changed its name to the Guelph Spring and Axle Co., Limited.

—On June 14th, His Lordship, Mr. Justice Lemieux, declared void the resolution of Sherbrooke City Council of 28th October last, which accepted the tender of R. W. Arkley, of $38,000, for building the dam at the Westbury Basin Water Power. A day's notice had not been given the councillors, hence the proceedings of the meeting were null and void.

THE TORONTO AND NIAGARA POWER DEVELOPMENT.*

Toronto, as a manufacturing city, has recently experienced great development, due almost entirely to its location, and shipping facilities, and not because cheap power was obtainable. The geographical conditions which surround the city are ideal for expansion, and it is safe to assume that with cheap and unlimited power available, the growth of the city, as a manufacturing centre, would be simply enormous.

These facts have been patent for some time, and it is, therefore easily understood how the Niagara power scheme came into existence. Before any definite steps were taken, the matter received considerable attention, for there were many obstacles to be overcome. Almost all the points raised, however, have been cleared up, and we have to-day the Electrical Development Co., whose charter calls for the development of power at Niagara Falls, Ont., and the Toronto and Niagara Power Co., which will transmit and distribute the power generated.

On January 29th, 1903, an agreement was entered into between the Commissioners of the Niagara Falls Park and Messrs. Mackenzie, Pellatt and Nicholls, giving these gentlemen the right to take water from the Niagara river, at Tempest Point, for the purpose of generating electricity to the extent of 125,000 electrical horse power.

*From a paper read by K. L. Aitken, of Toronto, at the Canadian Electrical Association.

On February 18th, 1903, the Electrical Development Co. of Ontario was incorporated, and this company took over the agreement just mentioned. As soon as possible, plans were drawn up and contracts for various portions of the work let, so that no time has been lost in expediting operations since the formation of the company.

The low-water flow from Lake Erie is somewhere in the neighborhood of nine million cubic feet per minute, and it is estimated that a larger percentage of this (possibly 65 or 75 per cent.), is owned by the Canadian Government.

The selection of the site of the power house was attended by a careful study of the conditions which have existed for the last six years in heavy water power installations, and particular attention was given to the plants in operation and under way, both on the American and on the Canadian sides of Niagara. Most of these installations have been made on a very large scale, and due consideration was given to the experiences of all the companies.

The construction of a deep, vertical wheel pit, and the discharge of water by the use of a low-level tunnel, having been demonstrated successful, and applicable to the geological conditions at Niagara, it was decided to lay out a power house using these principles. The point selected for the site seemed to lend itself particularly to this form of construction, as it was located sufficiently far from the edge of the Falls to remove it from the constant humidity at that point, and still not so far as to make the cost of the tail-race tunnel prohibitive. The site also provides an easy method of handling the ice which comes down the river, and this is one of the serious conditions which have to be dealt with at Niagara. There has been very little anchor ice noticed along the Canadian shore, although some difficulty has been experienced from this source on the other side.

Upon completion of the plans of the Electrical Development Co., the first step to be taken was the removal of the water which covered the site of the power house and wheel pit. At the time this work was commenced, it was recognized by all conversant with the plans, that the greatest difficulties that the company would have to encounter would be in the installation of the coffer dam, and the commencement of work on the main tail-race tunnel. It was considered by many that it would be impossible to carry out the work as outlined on the original plans, and it is certainly to the credit of the engineers that these difficulties have been overcome.

It was assumed in the original estimates that the depth of water would be about eight feet, as a maximum, on the line of the coffer dam. As the work proceeded, and it became possible to ascertain the depth of the river, it was found that in certain sections there was 26 feet of water, and not eight as originally figured upon; but in spite of this fact the dam was successfully placed in position. Besides the deep water, another difficulty encountered in the setting of the dam was the irregularity of the river bed. An immense number of boulders and fissures, of all shapes and sizes, was found, and upon this foundation the structure had to be built. Besides the actual setting there was the work of making the dam water-tight. When I visited the site recently, I found this matter in very good shape. In walking over the structure, I was impressed by its solidity, not the slightest vibration being noticeable.

When the dam had been run out into the river for a distance of about 600 feet, the depth of water increased to almost 24 feet, and as can be readily understood, the effect was decidedly severe, as the direction of the flow was at right angles to the end of the dam.

In order to break the force of the current, a fender was constructed of heavy timber, and placed against the upstream side of the cribwork, projecting beyond the last crib in place. This fender was held by three steel cables, passing along the outside face of the spur, where a winch was established to control the lines used in paying it out. The cribs were framed in the slack water below the dam and brought into place by means of stout tackle.

At a distance of 690 feet from the shore, the strain on the fender was so great, that the cables parted, and it was carried down the river, where it stranded about 150 feet from Tempest Point.

A new fender of heavier design was constructed, which served its purpose until the first [illegible] was r[illegible] attempting to move it over the cascade, it was [illegible] pieces by the force of the water, and carried over the Falls. At this point, however, the cribwork was running nearly parallel to the flow, and so no great difficulty was experienced in placing the cribs without its assistance.

As the site of the wheel pit was not entirely an[illegible] by the main dam, and as it was desirable to start work [illegible] the pit at the earliest possible moment, an inside dam was constructed. As the water in which this was set was practically still, no great difficulty was experienced in making it watertight.

The gathering dam will be constructed [illegible] stone and concrete, and from the upstream end d[illegible] a point about 150 feet from the power house, its top will be approximately level with the water. For the last 150 feet, the top of the dam will be about four feet below the water. Along the side of the power house will be built two rows of submerged ice arches, behind which will be located the screens. From this construction it will be seen that there will be a constant and heavy flow of water along the line of the arches, and that, therefore, any ice which is taken into the dam will be carried rapidly to the lower end, and discharged into the river.

In order to start work on the lower end of the tail-race tunnel, and drive back to the wheel pit, a construction tunnel of about 650 feet in length was required, and to ascertain the conditions under the Falls, as well as to provide for dumping the debris of excavation, an opening was planned about midway of this tunnel.

The rock encountered under the Falls is solid shale, and is absolutely dry. Mr. Value made a statement about this fact at a meeting of engineers at New York, and was laughed at, but it is absolutely true, and the dryness is evidenced by the fact, that when I was down in the tunnel, I put my hand up against a portion of the timbering, and drew it away covered with dust.

About 1,000 feet of the tunnel has been driven, and progress is being made at the rate of 50 feet a week. It is expected that work will commence at the upper end in the near future, and that the two will meet about October 1st of this year.

When the construction shaft had been sunk some distance, considerable trouble was experienced from water, the rock pierced being badly disintegrated. It was, therefore, necessary to concrete this shaft, which has proved fairly effective. There is some water coming in yet, but one small pump (the only one in the whole of the underground works), is sufficient to take care of it.

The shaft has a depth of 150 feet, and then turns and runs out under the river. At a distance of 385 feet from the shaft, the cross drift leading out under the Falls was begun.

Up to this time, the tunnel had been absolutely dry, but when the cross drift reached a point about 14 feet from the face of the cliff, a fissure in the roof developed, through which water came in considerable volume, flooding the tunnel, and causing a suspension of work. Pumps were installed and the water was lowered, but as preparations were being made for a blast, a portion of the roof collapsed, and a larger flow of water took place, again flooding the drift.

It was found that the water rose in the shaft to a height of 10 feet above the grade of the drift, before finding its level, thus indicating that the water came from the spray under the Falls, through fissures, whose openings were approximately at this level. This inference was completely borne out by subsequent examination.

A heavier pumping plant was installed, and the water lowered, thus allowing work to proceed. Holes were drilled in the face, varying in length from 18 to 22 feet, indicating a barrier of solid rock of about 12 feet in thickness, and beyond this a softer rock somewhat disintegrated, but of unknown thickness, none of the holes penetrating to the face of the cliff. As the flow into the drift was increasing in volume, and gaining on the pumps, it was decided to load the holes and blast away the barrier. In addition to the dynamite used in the holes, ten cases of the explosive were placed at the face of the cross drift, and the drift was allowed to flood before firing.

The blast broke down the solid rock barrier and opened a cut through the disintegrated rock and talus, out to the sheet of water, and down to an elevation about 12 inches below the drift roof.

The water fell to this level, and efforts were made to reach the opening by boat, in order to blast away the remaining barrier. A trip was made by three of the miners, and three cases of dynamite were placed in the most effective position, and fired. The blast tore a big hole in the rock, but did little or nothing towards removing the mass which prevented the water from escaping.

Failing in this attempt, two of the foremen successfully made the trip around behind the Falls, to the mouth of the drift. Starting from the Scenic Tunnel, these men, roped together, crept along the top of the talus, a distance of 450 feet, where they found the opening. A large amount of dynamite (in all, some 8,000 pounds), was carried out back of the Falls, and used in open blasts, making a large opening down to the level of the drift floor, and thus establishing complete drainage.

The wheel pit is designed for an installation of 11 turbines, and the tail-race tunnel comes up to a point 165 feet from its lower end, there branching into two lateral tunnels, which pass on either side of the pit. The intervening rock is pierced at intervals by draft tubes, which enter the tunnels through the invert, a water seal thus being preserved at all stages of operation. Single draft tubes are used, and each alternate wheel discharges into the same tunnel, six tubes entering the north tunnel, and five the south. Gates are provided for each side tunnel, so that it is possible by closing either gate, and shutting down the wheels discharging into this branch, to make an inspection while the other half of the station is in operaton.

The water which is taken in by the gathering dam, will be conveyed downward through steel tubes to the wheels at the bottom of the pit, and the difference of level is such, that, after deducting all losses due to friction, etc., there will remain an operating head of 143 feet. There will be two wheels on each shaft, the penstock entering between them. The old idea of having the top wheel somewhat larger than the bottom, having proved satisfactory, the same arrangement will be used, and the upward thrust thus produced will be just sufficient, at a predetermined gate opening, to balance the weight of the shaft and the revolving part of the generator above.

The wheel pit will be provided with a masonry lining, and the provision that the turbines and all of the machinery above them shall rest on solid rock foundations, instead of artificial supports, as has hitherto been the practice, is an element newly adopted for this construction, the value of which is evident.

The eleven generators will be installed on masonry foundations at the level of the power house floor, and the connections betwen them and the turbines will be made by use of hollow shafts, travelling in a vertical position, having a total length of approximately 115 feet, and supported at three intermediate points by solid masonry bearings. There will be one thrust bearing on each shaft, located just below the generator.

The placing of the labor of supporting the turbines, etc., upon solid rock foundations, and the provision of masonry intermediate supports for the shafting, are departures from previous practice, but have been adopted in order that the vibration in heavy revolving machinery may be reduced to a minimum.

The water, after passing through the turbines, will be discharged through steel draft tubes to the two branch tail race tunnels, connecting with the upper end of the main tunnel. This design is also a departure from previous practice, but has been adopted for two important reasons. First, it is not to be assumed that machinery can ever be installed without need of future repair, and second, by the use of two branch tail-race tunnels, it will be possible at any time to close down one-half of the station and make necessary repairs. In other words, the use of this double design makes in practice two stations out of one, each half being absolutely independent of the other. Another feature of the method of discharge is that the turbines themselves will always be accessible and not submerged at times, as in the case of some of the other plants.

In the first power house built on the American side, the turbines discharge at the bottom of the wheel pit into the open air, so that at all times the pit is very wet, owing to the spray. In the second power house draft tubes are used, and the general condition of things is better, but the scheme is such that the tail-race tunnel opens into the wheel pit, the draft tubes only preventing the throwing of water, and also giving an increase in operating head. In neither house is there any means of preventing the wheel pit from flooding, in case the water backs up in the tunnel. In the case of the Electrical Development Co. this is impossible with the construction used.

It has occurred in the Niagara River, below the Falls, that jams of ice have temporarily caused more than 50 feet of increase in the ordinary high water level below the Falls. If such a condition should exist when the Electrical Development Co.'s plant is in operation, the only result will be a reduction in the operating head during the temporary period, and not a filling up of the turbine chamber.

The water, after it is delivered to the branch tunnels, is by them delivered to the main tunnel, and is carried by means of this in a straight line and with a grade of five and a half feet per thousand to a point of discharge behind the main sheet of the Falls. This tunnel, in being straight, will be free from special erosion to its lining, due to a change in direction of rapidly-moving water, and the character of this lining will be such as to practically preclude the possibility of depreciation.

A point considered in the building of this lining is the fact that the Horseshoe Falls are constantly receding, and, for a distance of 300 feet from the lower end, the lining will be constructed in rings, six feet in length, so that, as the Falls recede, it will drop off in uniform sections, thus preventing cracking back of the portion shortened. The lining for the 300 feet mentioned, will consist of concrete, and for the balance of the distance two rings of hydraulic pressed brick will be used, backed solid to the rock with concrete.

A light steel observation gallery will be placed in the tunnel, running its entire length, by which it will be possible to make frequent examinations of the lining, etc.

The grade of the tunnel is sharper for the first three or four hundred feet. The water receives its initial velocity here, and the grade of the balance of the distance, namely, five and one-half per thousand, is sufficient to maintain this speed.

The total water required by the new power house, when under full load, will be in the neighborhood of 700,000 cubic feet per minute, or about 7.7 per cent. of the minimum flow.

Below are given a few figures in connection with the underground work: Depth of construction shaft, 150 feet; length of construction tunnel, 670 feet; length of main tail race tunnel, 1,935 feet; length of each branch tail race tunnel, 550 feet; from power house floor to bottom of wheel pit, 158 feet; length of wheel pit, 416 feet; width of wheel pit, 22 feet. The dimensions of the power house will be: Length, 500 feet; depth, 70 feet; height, 40 feet. Generally speaking, the structure will be built of light granite.

As to the electrical end of the development, very little information is ready for publication as yet, and, therefore, my remarks, under this heading, will be limited.

In the power house there will be eleven generators, each of 12,500 horse power capacity.

The machines are wound 25 cycle, three-phase, 12,000 volt current, and having 12 poles, will revolve at a speed of 250 revolutions per minute. Some figures in connection with them are given herewith:

Outside diameter, 18 feet 4 inches; height, 12 feet; diameter of revolving field, 12 feet 4½ inches; airgap, ¾-inch; weight of revolving element, 141,000 pounds; weight of complete machine, 400,000 pounds; diameter of shaft, 15 inches, with 8-inch hole.

I have no data on the exciters, but presume that these will be wound for 125 volts, and that some will be water wheel driven and some motor driven. The power house

switchboard will be simple in principle, the only apparatus needed being that to control and synchronize the generators, and handle the exciters.

From the power house, underground ducts will be laid to the transformer house about 900 feet away, where the current will be stepped up to 60,000 volts and transmitted to Toronto.

The route of the transmission line has been laid out, and a right of way with a minimum width of 80 feet has been acquired, the total distance being 75½ miles.

The location of the line has been selected with a view not only to electric power transmission, but to railway purposes also, and it may be noted that the country traversed does not present serious engineering difficulties. There will be very few curves, and the sharpest will have a radius of not less than 1,600 feet.

I understand that current will be distributed in Toronto by underground cables, at a potential of 13,200, to a number of sub-stations, where, for local distribution, it will be reduced again or changed to direct current by means of rotary converters or motor-generator sets.

Little or nothing is known about the transmission line itself, except that it will follow generally the design used by the Mexican Light and Power Company, which was one of the first concerns on this continent to adopt long spans.

In the Toronto-Niagara line two rows of steel towers will be used, each pole supporting two three-phase circuits. The towers will be about 50 feet high, and will set about 400 feet apart. Each cable will be made up of six No. 0 wires, stranded together around a hemp core. This construction gives a wire that is very flexible, considering its area, and also gives the form of a hollow conductor. The cables will be arranged in the shape of an equilateral triangle, a distance of from five to six feet separating the wires of each circuit. The practice in America is to set the triangles so that one side in horizontal. In almost all European lines, one side of the triangle is set perpendicular, which seems a much better arrangement as it reduces to a minimum the danger of the wires swinging together, and this, I should think, is a point requiring much consideration, in long span work. I do not know which method will be used on the line under consideration.

This insulator is made of brown glazed porcelain and weighs about 22 pounds. The greatest width is 15 inches, and the overall height is 14 inches. The distance of surface leakage from the tie wire to the pin is about 40 inches; the striking distance being approximately 21 inches.

The Electrical Development Company has secured a property of 530 acres, in the vicinity of the Falls—to be rented or sold for manufacturing or other purposes. The land has a frontage on the Welland River of over one and one-half miles, and is located about three miles from the mouth of the river, and about two miles from the town of Niagara Falls. It is expected that this land will be taken up by manufacturers using electro-chemical processes, or other large power-using businesses.

GRAIN PRESSURE IN DEEP BINS.*

By J. A. Jamieson, C.E., Montreal.

(Concluded.)

To obtain the relative vertical and lateral pressure produced by the grain, we divide the pressure per square inch on the bottom of the bin by the pressure per square inch on the side of the bin, both having been obtained by means of the hydraulic diaphragm and gauge. In every case, when wheat was being used for testing, we found the lateral pressure to be approximately equal to 60 per cent. of the vertical pressure, or the vertical pressure to be equal to 1.67 per cent. of the lateral pressure. This agrees exactly with the angle of repose of 28 degrees for wheat which was obtained by means of the apparatus shown.

To obtain the relative pressures due to the increased depth or diameter [illegible] with a depth equal [illegible] square, and a depth [illegible] round bins 6-in. [illegible] times the diameter [illegible] depth 6.5 times [illegible] case that the pressures [illegible] lateral in the larger bins [illegible] as in the smaller bins [illegible] bottom of the larger bins [illegible] great as in the smaller bins [illegible]

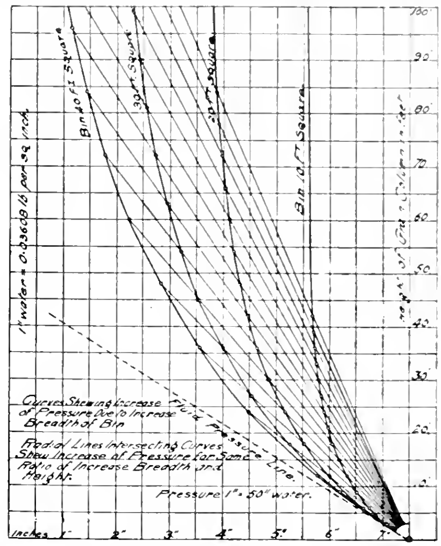


Diagram Illustrating the Ratio of Increase of Pressure with Increased Breadth and Depth of Bin.

the weight for four 6-in. bins. The proportion of the grain weight carried by the sides is dependent upon the ratio of horizontal area or the weight of the grain column, to the area of the bin walls, and if we increase the breadth and maintain the same ratio of breadth to depth, the pressure will increase directly as the breadth. As, however, the maximum pressures are reached at a depth of 3.5 times to 4 times the breadth, it may be stated that approximately both the vertical and lateral pressure will increase directly as the breadth.

Taking wheat weighing 50 pounds per cubic ft. as a standard, we find that corn weighing 45 pounds per cub. ft. will give approximately the same pressure per square inch as wheat; this being due to the slightly lower co-efficient of friction between the corn and the bin walls. Peas, weighing 50 lbs. per cub. ft., give a vertical and lateral pressure of about 20 per cent. more than wheat; while flax-seed, weighing 45 lbs. per cub. ft. will give a lateral pressure 10 per cent. greater and a vertical pressure 12 per cent. greater than wheat, this being due to its lower angle of repose, and lower co-efficient of friction. A bin designed with a proper factor of safety for wheat, will, however, be quite safe for the storage of peas or flax-seed. Taking a trough plate bin filled with wheat as a standard, and with a depth of bin equal to the breadth, we find that 57.1 per cent. of the grain load is carried on the bottom and 42.0 per cent. carried by the walls. At a depth equal to twice the breadth, 38.0 per cent. is carried on the bottom, and 61.1 per cent. by the sides. Depth equal to four times the breadth, 21.9 per cent. on the bottom and 78.1 per cent. by the sides. Depth equal to five times the breadth, 17.6 carried on the bottom and 84.9 per cent. on the sides. Depth equal to six times breadth, 15.1 per cent. carried on the bottom and 84.0 per cent. on the sides. Depth equal to 6.5 times the breadth, 13.0 per cent. carried on the bottom, and 86.1 per cent. by the sides. The above is for the weight of grain in the prism of the bin only, and if the bin is provided with a hopper bottom, the full weight

*From a paper read before the Canadian Society of Civil Engineers.

the contents of the hopper bottom must be added to the bottom load, since the walls cannot carry any part of this weight.

Dealing with the question theoretically, it is well known that if we pour grain upon a level floor, it will assume the form of a cone with sides at a considerable angle from the horizontal, and if we endeavor to run grain through a spout, the spout must have a considerable angle before the grain will run, thus clearly indicating a considerable friction, both of grain on grain and between grain and the spout or bin wall. If there was no friction between the grain and the bin walls, the total grain weight would rest on the bottom, and if there was no friction within the mass of grain, the horizontal pressure would be equal to that produced by a fluid of the same specific gravity as grain; it is this friction on the one hand and the lack of cohesion between the particles on the other, that distinguishes a granular mass from either a fluid or a solid. The material and form of the walls also will have a great influence on the pressures. The following is a table showing these variations:

TABLE OF CO-EFFICIENT OF FRICTION.

Between wheat and various materials of bin walls. Wheat used for all pressure tests No. 1, Manitoba hard, weighing 50 lbs. per cubic foot. Angle of repose 28° = 0.532 co-efficient of friction:

TABLE OF CO-EFFICIENT OF FRICTION.

Wheat on	wheat	0.532
" "	steel through plate bin	0.468
" "	steel flat plate, riveted and tie bars	0.375 to 0.400
" "	steel cylinders, riveted	0.365 to 0.375
" "	cement-concrete, smooth and rough	0.400 to 0.425
" "	tile or brick, smooth or rough	0.400 to 0.425
" "	cribbed wooden bin	0.420 to 0.450

We now find that the proportion of the total weight of grain in a bin that would be carried by the walls and on the bottom of the bin, and therefore the intensity of both the vertical and lateral pressures produced by grain is entirely dependent upon the following factors:

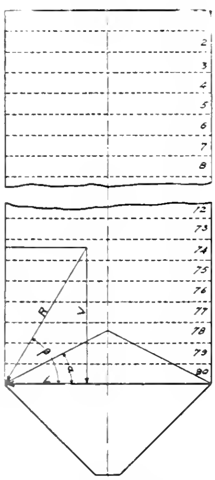
(1) The co-efficient of friction between grain and the bin walls.

(2) The ratio of the breadth or diameter of the bin to the depth.

(3) The ratio of the horizontal area or weight of the grain column to the area of bin walls.

(4) The angle of repose of grain, or the ratio of the lateral to the vertical pressure.

The latter is fully shown by the diagram.



V = Intensity and Direction of Vertical Grain Pressure
L = " " " Lateral " "
R = " " " Resultant " "
α = Angle of Repose or Natural Slope of Grain
β = " " Shear $45° + \frac{\alpha}{2}$ $V = L \tan \beta = \sqrt{R^2 - L^2}$ $L = V \tan 90° - \beta = \sqrt{R^2 - V^2}$
$R = L \text{ secant } \beta = V \text{ secant } 90° - \beta = \sqrt{V^2 + L^2}$
For Wheat α = 28° β = 59° V = 1.665L L = 0.6V R = 1.167V = 1.94L

Having established the factors and their values which govern the pressures, it is easy to determine the vertical and lateral pressures and the proportion of the weight of the contents of a bin of any given breadth and depth, or construction of walls, that will be carried by the walls and on the bin bottom.

To illustrate, we will assume a bin 10 ft. square, 100 sq. ft. horizontal area, filled with wheat weighing 50 pounds per cubic foot, each layer one foot thick will contain 100 cubic feet weighing 5,000 lbs. and the area of the four walls for one foot in depth of bin, will be 40 square feet. Starting with the top layer, we find that the lateral pressure, and therefore the friction between the grain and the walls, is very slight and may be neglected, and assume that the full weight of the first layer is resting on top of the second layer.

We therefore have:

$$\frac{5000 \times 40 \text{ sq. ft.}}{100 \text{ sq. ft.}} \times 0.6 \times 0.41667 = 500 \text{ lbs. carried by the walls.}$$

This 500 lbs. deducted from the weight of the second layer will leave 4,500 lbs. (which we will call the remaining weight), plus the full weight of the first layer, making 9,500 lbs. which will rest on top of the third layer, and will produce lateral pressure in the third layer sufficient to support 950 lbs., which, deducted from the weight of the third layer, will give a remaining weight of 4,050 lbs. This remaining weight of the third layer plus the remaining weight of the second layer, and the full weight of the first layer, will produce pressure on top of the fourth layer, and so on for all succeeding layers. As the weight on top of each layer increases, the lateral pressure will be correspondingly increased, and the greater the pressure against the walls, the greater proportion of each layer that will be supported by the walls. The total weight on the bottom of a bin containing any number of layers of grain will be equal to the sum of the weight of the top layer plus the remaining weights of all succeeding layers, and the weight carried by friction on the bin walls will be the difference between the weight on the bottom and the weight of the total amount of grain in the prism of the bin.

Also Proportion of Grain Load Carried by Bin Walls and on Bin Bottom.—Calculated by Step Process.

Bin 20 ft. square, 80 ft. deep. Wheat = 50 lbs. per cub. ft. Weight, 1 ft. depth = 20,000 lbs. Horizontal area of bin 400 sq. ft. = 57,600 sq. inches. Area of four walls for 1 ft. depth = 80 sq. ft. = 11,520 inches. Co-efficient of friction between grain and bin sides = 0.41667.

$$\frac{20{,}000 \times 400}{0.41667 \times 80 \times 0.6}$$

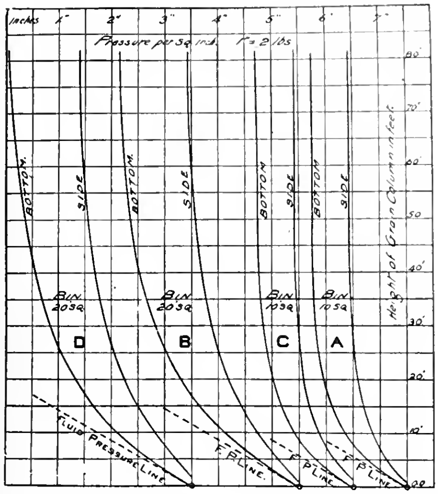
Angle of Repose of Wheat 28°

L = 0.6 V.

Height of Grain Ft.	Weight in Bin. Lbs.	Car. by Sides per ft. Lbs.	Car. by Sides Totals. Lbs.	Car. on Bottom per ft. Lbs.	Car. on Bottom Totals. Lbs.	Pressure per sq. in. lbs By Step Process Lat.	By Step Process Vrt'l	By Pressure Factors. Lat.	By Pressure Factors. Vrt'l
1	20000	000	000	20000	20000	0.00	0.34	0.00	0.00
2	40000	1000	1000	19000	39000	0.21	0.66	0.00	0.62
3	60000	1950	2950	18050	57050				
4	80000	2853	5803	17147	74197				
5	100000	3710	9513	16290	90487	0.77	1.54	0.56	1.59
6	120000	4524	14037	15476	105963				
7	140000	5298	19335	14702	120665				
8	160000	6033	25368	13967	134632				
9	180000	6732	32100	13268	147900				
10	200000	7395	39495	12605	160505	1.54	2.73	1.34	2.76
15	300000	10247	85317	9753	214683	2.14	3.65	2.02	3.67
20	400000	12453	143395	7547	256605	2.59	4.36	2.51	4.33
25	500000	14160	210955	5840	289045	2.95	4.91	2.91	4.90
30	600000	15481	285955	4519	314145	3.23	5.34	3.21	5.34
35	700000	16504	366434	3496	333566	3.44	5.67	3.46	5.64
40	800000	17295	451405	2705	348595	3.60	5.93	3.63	5.89
45	900000	17907	539779	2093	360221	3.73	6.12	3.75	6.10
50	1000000	18380	630780	1620	369220	3.83	6.28	3.87	6.28
55	1100000	18747	723818	1253	376182	3.91	6.40	3.96	6.43
60	1200000	19030	818430	970	381570	3.97	6.49	4.02	6.55
65	1300000	19250	914262	750	385738	4.01	6.56	4.08	6.67
70	1400000	19319	1011041	581	388959	4.05	6.61	4.14	6.76
75	1500000	19551	1108544	449	391456	4.07	6.66	4.18	6.82
80	1600000	19652	1206612	348	393388	4.09	6.69	4.20	6.88
Maximum		20000		0	400000	4.17	6.94		

The co-efficient of friction of 0.41667 was chosen to reduce the amount of work required in calculating this table, 0.41667×0.6 being 0.25.

The discussion on Mr. Jamieson's paper extended over three meetings of the society, Dr. Bovey, John Kennedy,



Comparative Curves—Bins 10 ft. and 20 ft. square, 80 ft. deep. A. and B. derived from theoretical calculation. C. and D. derived from tests. Wheat = 50 lbs. per cub. ft. Angle of repose 28°. Co-efficient of friction between grain and bin sides = 0.41567.

Phelps Johnson, Max Toltz, H. E. Vautelet, and others, taking part. The discussion ran largely into controversial matters arising out of the report of engineers of the Public Works Department, appointed to examine Mr. Jamieson's plans for the Montreal harbor elevator.

Mr. Toltz gave from memory, the results of tests he made at West Superior in a bin 14 ft. square and 65 ft. deep, with a view to obtaining data by which to design the West Superior elevator. The tests were made in a bin of a wooden elevator, but the bin was lined with sheet iron, to imitate the steel bin which they proposed to build. He stated that they found the horizontal pressure did not exceed three pounds per square inch. This agrees with the present author's tests and also those made by Dr. Bovey, when he used the co-efficient of friction for steel instead of wood. Mr. Toltz stated that if he had had this information at the time of designing the Great Northern Elevator, at Buffalo, he could have saved from $75,000 to $100,000.

Mr. Johnson said he had watched a number of tests which Mr. Jamieson made in the model bins. He was satisfied that the results obtained were accurate and that the appliances used were suitable, and he illustrated by wooden bin construction that the pressures could not very much exceed the pressures obtained from these tests, without seriously endangering the wooden elevator bins, which have stood successfully for many years.

Dr. Bovey said he was satisfied that the results obtained by Mr. Kennedy and himself were very near absolute accuracy. These diaphragms were calibrated in direct hydraulic pressure, and also with test weights both before and after the experiments, and were found to give absolutely correct results. It was true that there must be a slight depression of the rubber diaphragm when the pressure is applied, but this depression is so very slight compared with the rise of the mercury in the gauge as to have no effect on the results.

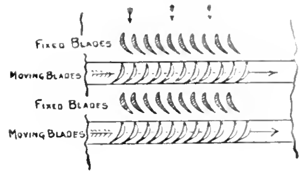
Mr. Kennedy said that anyone who had worked with these diaphragms for half an hour would question them. Every train that passed through the yard, causing a vibration, had its effect on the diaphragm and the gauges showed it instantly.

THE TURBINIA.

The new turb[illegible] service between Hamilton [illegible] T[illegible] arr[illegible] from England, and is beginning her regular tr[illegible] as we g[illegible] press.

The steamer is 200 feet in length [illegible] breadth, and 20 feet 9 inches in depth, and will carry between 1,500 and 2,000 passengers. The promenade deck, as will be seen from the accompanying photo, has a fi[illegible] clear space forward and aft. The hurricane deck is also available as a promenade deck, being clear from end to end, except for the

Fig. 1.



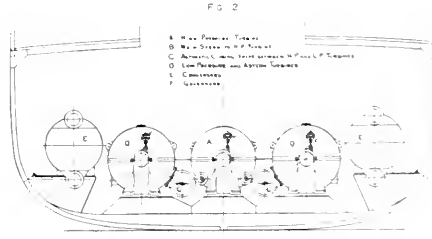
Blades

space required for life-boats, etc., and for the wheel-house forward. The boat is heated by steam and lighted by electricity, a powerful searchlight being installed on the bridge. The interior is finished in polished mahogany and the seating accommodation in the spacious saloon is tastefully upholstered in velvet.

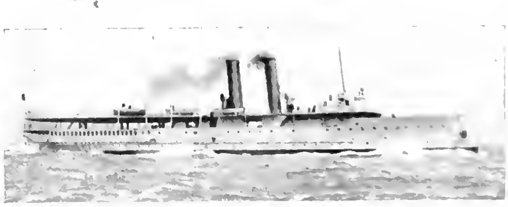
The Parsons Turbine, which is the novel feature of this boat, is familiar to readers of the Engineer, but a brief description of the salient features might not be out of place.

The turbine consists of a fixed cylindrical case within which is a revolving shaft. Upon the inside of the case are fixed blades or guides, and on the shaft also are blades pro-

Fig. 2



jecting outwardly. As the diameter of the shaft is less than that of the case, an annular space is left between the two, which is occupied by the fixed and moving blades, and through which the steam passes. The steam enters the cylinder in an axial direction by means of an annular port in the forward end, and meets a ring of fixed guide blades which deflects it so that it strikes the adjoining ring of moving blades at such an angle that it exerts on them a rotary impulse. When the steam leaves these blades, it has naturally been deflected, and a second ring of fixed blades is interposed to direct it at the proper angle to the second ring of rotating blades. The same thing occurs with succeeding



Turbinia.

rings or guides and moving blades until the steam escapes at the exhaust passage. Fig. 1 shows the arrangement of blades, the short arrows indicating the axial direction of the cylinder and the direction of flow of steam, and the long arrows the direction of rotation. Fig. 2 is a cross-section showing the

arrangement of turbine machinery. There are three turbines, one high pressure in the centre of the ship, and two low pressure, one on each side of ship. Each turbine drives a separate shaft, with one propeller on each shaft. Inside the exhaust casing of each of the low pressure cylinders, a reversing turbine is fitted. In ordinary forward motion the steam is admitted to the high pressure turbine, and after expanding about five-fold, it passes to each of the low pressure turbines in parallel, and is again expanded by them about 25-fold, when it passes to the condensers. The total expansion ratio is thus 125-fold.

When manoeuvring in or out of a harbor, the outer shafts only are used, and the port and starboard engines are capable of being worked ahead or astern independently of each other and of the high pressure turbine.

The two Scotch boilers in the Turbinia are each fitted with four Morison Suspension Furnaces, made by the Leeds Forge Co., Limited, the original manufacturers of corrugated furnaces. George Holland, C.E., Montreal, is Canadian agent for the Leeds Forge Co.

The Turbinia was built by Leslie, Hawthorn & Co., Newcastle-on-Tyne, and is operated by the Turbine Steamship Co., Limited, of Hamilton. She is the first turbine steamship on fresh water, and the first mercantile turbine steamer to cross the Atlantic.

THE POWER AND LIGHTING EQUIPMENT OF SOULANGES CANAL.

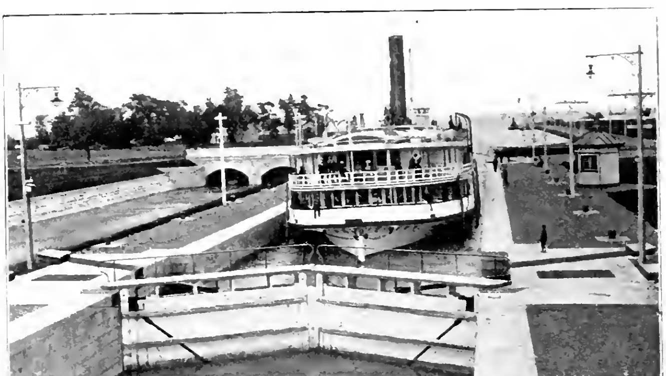
The following is an synopsis of an instructive description of this work given by J. Kynoch, chief engineer of the Canadian General Electric Company, before the Canadian branch of the American Institute of Electrical Engineers.

The extensive series of rapids on the St. Lawrence river route, between Prescott and Montreal, have necessitated a chain of canals being built to accommodate the large and continually increasing freight traffic. These canals are arranged to provide 14-ft. navigation, and this is the only route by which boats of this draught can now pass from Lake Superior to the Atlantic. The Soulanges Canal is a link in this chain. It is about fourteen miles long and couples Lake St. Francis with Lake St. Louis, and it replaces the old Beauharnois Canal, which was built for vessels of 9-ft. draught only.

The design of locks, location of same, and superintendence of construction was entirely in the hands of the late Thomas Monro, past president of the Canadian Society of Civil Engineers. It is generally conceded that this canal represents a piece of hydraulic engineering second to none on this continent.

The canal starts at Coteau Landing, on Lake St. Francis, and ends at Cascades Point on Lake St. Louis. The level of water at Coteau Landing is, on the average, 82.5 feet above level at Cascades Point. This difference in level is taken care of in five locks, each 280 feet long by 46 feet wide. These locks are numbered 1 to 5, starting at lowest water, viz., Cascades Point. Locks 1, 2, and 3 are designed for a lift of 23.5 feet each; lock 4 for a lift of 12 feet, and lock 5, which is the guard lock, has a lift of about 2 feet. The canal is spanned by seven highway bridges. It is to operate the locks and bridges and to light the canal banks throughout, that the electrical plant was designed, and the following is a description of same:

Soulanges Canal—Power House at Grease River.



Lock No. 5, Soulanges Canal.

Power House.—This is a neat and tastefully designed building of red brick, and is situated about five miles from the upper or Coteau Landing entrance to the canal. At this point the Grease river crosses the canal, being led under the canal in a 10-ft. culvert, and empties into the St. Lawrence. Advantage of this was taken to make the river a tail race, the supply of water for the turbines being taken from the canal, which provides a 20-foot head. The hydraulic portion of the plant consists of two-wheel chambers, in each of which are two pairs of Victor turbines on one shaft, which passes through the usual stuffing box into the generator room. To each of these shafts is direct connected a 2,400-volt, 3-phase, 264-K.W., 60 cycle Canadian General Electric revolving field type generator, operating at 225-R.P.M. The two exciters, which are four pole, 13½-K.W., 125 volt machines, are belted to the water wheel shafts. The switchboard consists of two generator panels, two feeder panels, and one exciter panel, fitted with the usual instruments; provision is made to run generators and exciters separately or in parallel.

Pole Line.—From the four feeder switches on the feeder panels are led four 3-conductor lead covered cables, which pass under the canal to a lightning arrester cabin on the opposite bank of the canal. In this cabin each conductor is connected to a fuse block and a C.G.E. Wirt lightning arrester, and from thence it passes to the pole line.

There are four three-phase circuits leading from the

cabin, two to the upper entrance of the canal, each of No. 6 B. & S., one for power and the other for arc lights, and two circuits to the lower entrance of canal, one of No. 2 B. & S. for arc lights, and the other of No. 4 B. & S. for power. All wires are bare copper.

As lightning storms are very severe in the locality of the canal, and as the continuity of service of a plant of this kind is of immense importance, a lightning arrester has been placed on every wire which is tapped from the main line, and which passes in close proximity to ground or in which there was the least chance of a ground occurring due to lightning. There has never been a shut down from this cause.

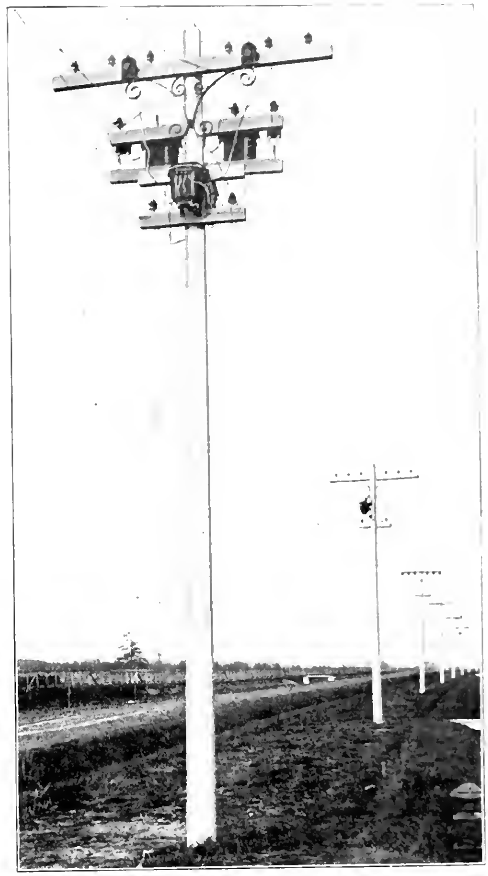
The poles, which are 30 and 35 ft. long of cedar, sawn octagonal, and set 6 feet in the ground and 120 feet apart, were brought from British Columbia; the cross arms, which are of red pine, are supported by an ornamental cross arm brace making a very artistic-looking line.

ARC LAMP.—The general lighting of the canal consists of 7½ amperes, alternating, multiple, enclosed arc lamps placed 480 feet apart on one side of the canal. Each lamp is supplied with current from a 1,000 watt, 2,080/115 volt, C.G.E. type H. transformer. Before deciding on the system of lighting to be adopted, the various merits and demerits of series and multiple systems was thoroughly discussed, and at that time the decision was given in favor of the multiple system. For canal lighting at night, the continuity of service is of immense importance, for the reason that if light failed, when a vessel was approaching a bridge or a lock, a collision might ensue, resulting in damages amounting to thousands of dollars, and it was thought at that time that as a short circuit across the line was a very remote contingency, the point for comparison was the breaking of a lead to a lamp; in the case of multiple lamps, only one lamp would be out, while in the series system all the lamps on that circuit would be out, which would mean every second or third lamp.

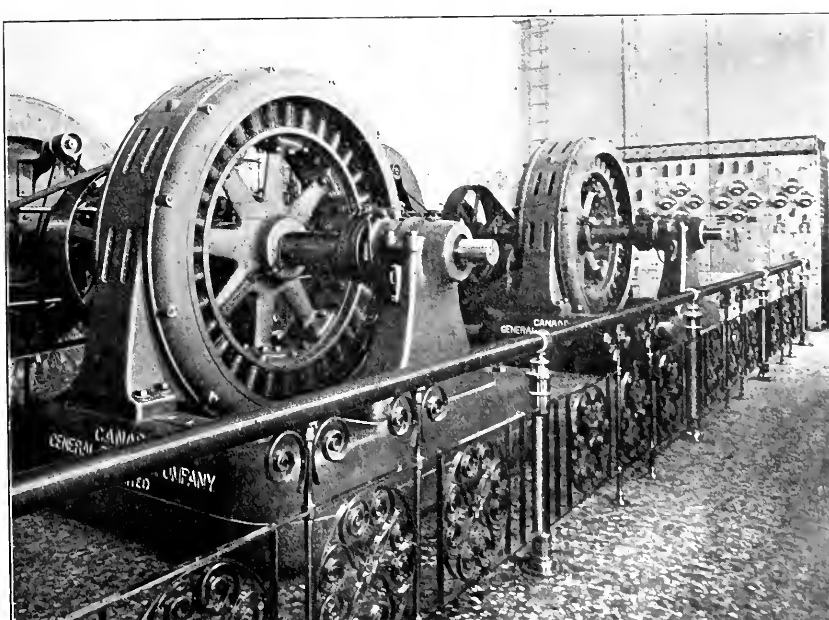
At the locks and bridges, the lamps are spaced closer, and are on both sides of the canal. The same arrangement also exists at upper and lower entrance to canal.

The arc lamp brackets are of neat design and artistic appearance, the supporting cable, which is of steel passes through the centre of bracket pipe, through pole, and over a pulley and down to a windlass, which is locked to prevent unauthorized persons tampering with the lamps.

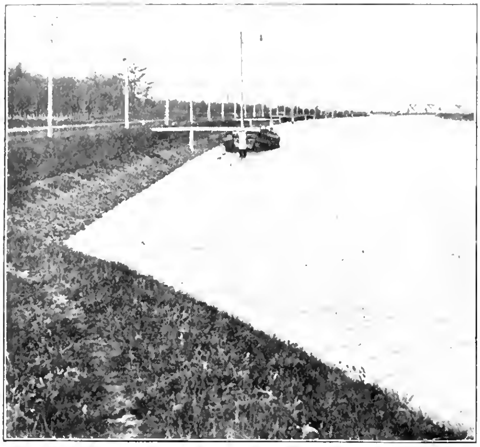
HIGHWAY BRIDGES.—These are of 180 feet span and weigh about 100 tons; the operating apparatus consists of a



Transmission Line—Pole with Bridge Motor Transformers in Foreground.



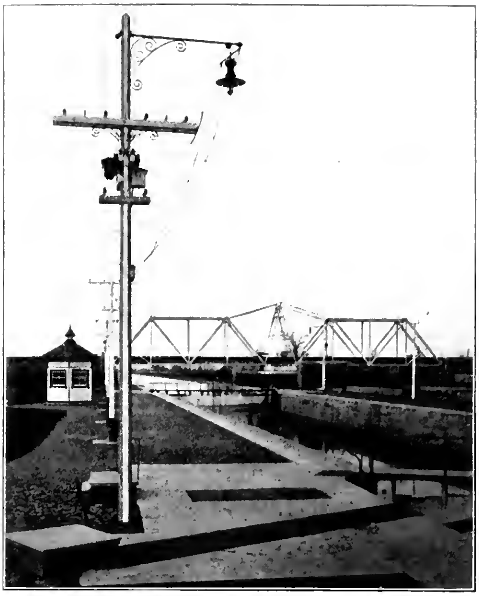
Interior of Power House.



Lamp Poles.

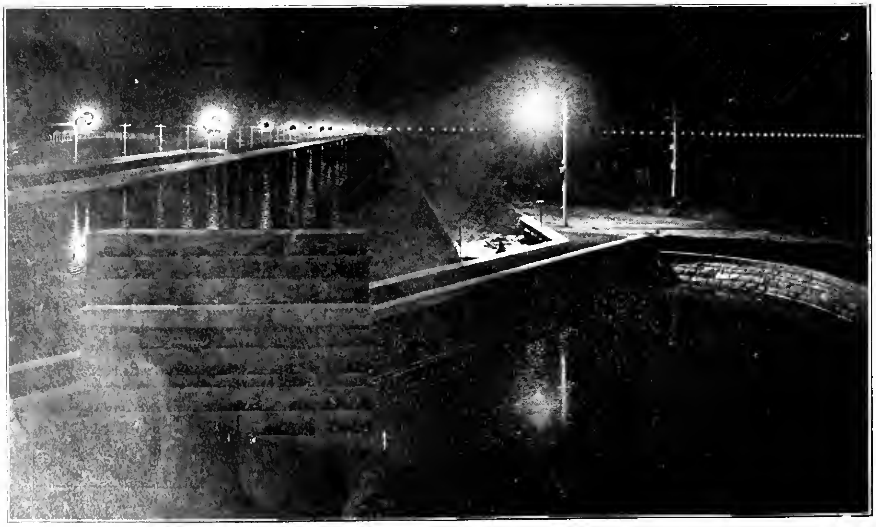
gear and friction mechanism driven by a 2-h.p., 220-volt, 3-phase induction motor located in a cabin of very attractive appearance placed in centre of bridge. The mechanism opens or closes the bridge in two minutes

The pinion A on the motor shaft drives a gear B on a countershaft on which is keyed a paper friction pulley C. This countershaft turns in bearings D, which are located on



View of Lock, Showing Location of Motor Boxes, Lamp Poles, and Switch Cabin.

Operating Cabin and Signal Lamp on a Highway Bridge.



Night View on Canal.

the ends of two arms or links; the other ends E of these links are held by studs which are axially on a line with centre of motor shaft. The bearings in which the countershaft turns are also connected by means of links to cams on another shaft F, on which is secured a lever G.

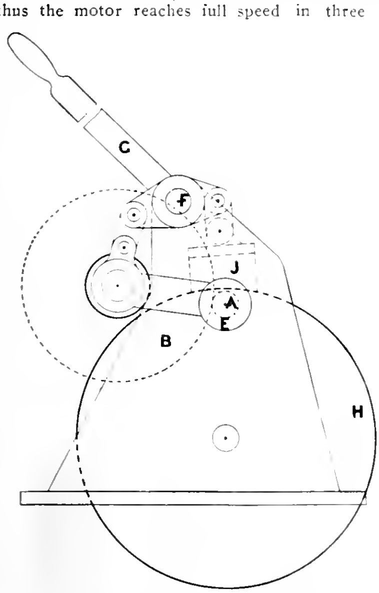
By moving the above mentioned lever in one direction, the paper friction pulley is brought into contact with a cast iron friction pulley H, which is keyed to the main shaft, which operates the bridge mechanism through a bevel pinion and gear.

On the above mentioned lever shaft F is located another cam, which is attached by means of a link to a brake shoe J; this shoe is brought into contact with the cast iron friction pulley by moving the lever in a direction opposite to that above referred to.

It will be noted from the above that by a simple movement of the lever in one direction the bridge can be started in motion, and by moving lever in the opposite direction the motion can be retarded or stopped. The direction of motion of the apparatus is reversed by a reversing switch in the motor circuit.

In the design of the above mechanism, two important points have been taken care of, viz.: (1) The paper friction pulley is brought into and taken out of contact with iron friction pulley without the motor pinion and gear getting out of true mesh with each other. (2) The brake cannot be put into operation unless the friction pulleys are thrown out of contact with each other.

In starting up this apparatus, the motor is started practically without load, the load being only the friction of motor and countershaft bearings, and the small motor pinion and gear, thus the motor reaches full speed in three or four

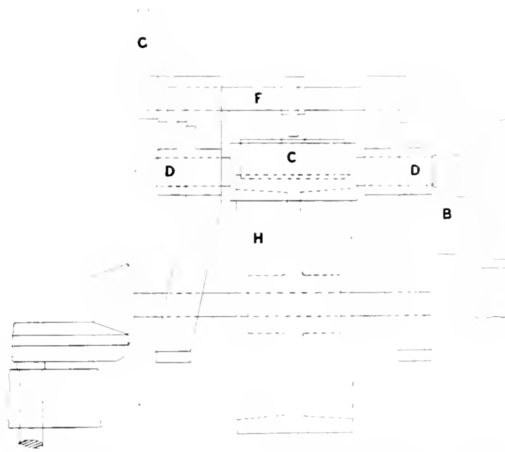


Mechanism for Opening and Closing Bridge. CC, Paper Friction Pulley. D, Bearings. B. Gear.

seconds, and the load is gradually applied by means of the lever and friction pulleys. The load being thus applied very gradually overcomes the jerking and whipping action, which is always incident to long, narrow bridges of light construction, such as those crossing this canal.

Each bridge is equipped with a large electric signal lantern which is placed on a line passing through the centre of the canal prism or navigable channel. This lantern shows, at night, a red light when bridge is closed, and a green light when bridge is open. The lights inside lantern, which consist of groups of incandescent lamps, behind which are placed metal reflectors, are controlled by a switch inside motor cabin.

Lock and Sluice Gate Mechanism.—The larger lock gate is 28 ft. wide and over 40 ft. high and weighs about 70 tons. Each gate turns in a [illegible] walls of lock, its heel rests upon a post [illegible] held by a gudgeon and collar at the top. It [illegible] on a hinge and hangs free in air, which is unlike any other lock gates in Canada. It is closed or opened by means of a strut, at the end of which is a rack and pinion mechanism, which in turn is operated by a friction mechanism, involving the same principles as that described previously for operating bridges, and which is driven by a 3-h.p. 220 V-3-phase motor. This mechanism is enclosed in a cast iron box which

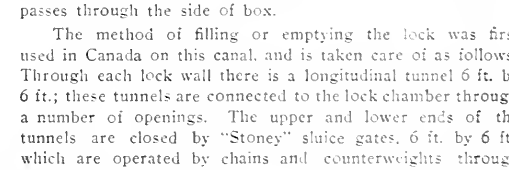


Mechanism for Opening and Closing Bridge. A. Pinions. B. Gear. E, End of Link. F, Shaft. G. Lever. H, Cast Iron Friction Pulley. J, Brake Shoe.

projects about 15 inches above coping of lock. These motor boxes have on the outside an indicator which shows just when gate is full open or closed. The gate is opened or closed in one minute. The handle of a reversing switch passes through the side of box.

The method of filling or emptying the lock was first used in Canada on this canal, and is taken care of as follows: Through each lock wall there is a longitudinal tunnel 6 ft. by 6 ft.; these tunnels are connected to the lock chamber through a number of openings. The upper and lower ends of the tunnels are closed by "Stoney" sluice gates, 6 ft. by 6 ft., which are operated by chains and counterweights through vertical wells 8 ft. by 4 ft. in the masonry, extending from lock floor to coping.

To fill the lock the lower sluice gates are closed, and the upper ones opened allowing the water to pass through the tunnel and opening into the lock, as these openings are equally divided between both sides of lock, the pressure of the incoming water on the two sides of a vessel is balanced,



Plan of Locks 2 and 3.

and so vessels do not surge about when lock is being filled or emptied. The lock can be filled in three minutes.

The chains and counterweights, which suspend the sluice gates, are hung on a horizontal shaft which passes into a cast iron box containing a 1-h.p., 220-volt, 3-phase motor and friction mechanism, as described for bridges, and operated by a lever in the same way. These boxes project above lock coping about fifteen inches and also have an indicator which shows when gate is closed or full open. A small lever, fastened to a spindle passing through side of box, operates a reversing switch. The sluice gates can be opened or closed in three-quarters of a minute.

SWITCH CABINS.—At each lock there is a switch cabin, which contains two transformers for stepping down from 2,200 to 220 volts for the motors. One main switch controls all the motors at the lock. From this switch, through Noark fuses, pass cables leading to each motor.

The plant, as above described, has been in operation for two years without a single breakdown.

AN ARCTIC EMPIRE.

Editor, Canadian Engineer:—

SIR,—French fishermen, American whalers, and Hudson Bay traders are exploiting the natural resources of our "Norland," with little or no benefit to Canada at large. They are now establishing "vested rights," to be cancelled at some future date by a heavy ransom. To conserve the remainder of the public domain from foreign or corporate selfishness, is the pressing duty of every patriotic citizen. In the prosperity of Finland, the exports of Norway and Sweden, and the almost boundless wealth of Siberia, we have an object lesson for Canada to ponder and improve upon. Upon how thoroughly we con it will largely depend our future destiny.

Wheat grows to perfection on Great Slave Lake; vegetable gardens pay at Dawson City, and hardy grains flourish in Sweden up to the Arctic Circle. From the northern boundary of the prairie, we have an average of 300 miles, fairly timbered, abounding in fur; beyond that, peat is more or less abundant, until the frost-bound tundras impinge upon the Arctic Ocean, and in the Franklin Islands and west coast of Greenland, extensive deposits of coal are known to exist. The tar sands of the Mackenzie Basin will, in coming ages, supply light and fuel to the inhabitants; and the mines of Caribou, Cassiar, Klondyke, and Porcupine, may reasonably be expected running N 60° E. as in other mineral countries. The Cape Nome sands are worked southwest to Lake Baikal, and why may they not be also continuous across our territory?

The multiplicity of lakes and streams, from the 52nd to 68th parallels of latitude, gives a belt of over eleven hundred miles, suitable for the greatest fur preserve on the globe; while Alaska seals may be tried in Hudson Bay, and may possibly discount the value of the Pribilof Islands in the fur markets.

Briefly, our wheat belt (capable of a billion bushels per annum), with phosphates enough to ensure permanent fertility; our timber and water power, for pulp, etc., beyond; our peat, coal, and petroleum resources; our fur, game, and fishing capacity; our mineral wealth, and the hardy, active, honest men, such employment must breed, will make the model Northmen of earth's history.

The Jews had to be quarantined forty years in Midian to wipe out the stain of Egyptian slavery before entering on the conquest of Palestine; and the Hudson's Bay Co. spent two centuries in making the most perfect single object corporation on earth, and to cover the varied fields of industry suggested we will need only to copy and extend their methods. The Greeks and Romans were more co-operative than modern nations in extending government to social conditions, and we may learn much of national possibility from the present conflict in China as to how much cheaper and more effective government action is than private initiative. I would briefly suggest a method by which much might be effected:

1. By enlisting strong, healthy, young men of fair education, total abstainers, and each trained to some handicraft required, for seven years, with chances of re-enlistment and promotion till 21 years; and those having unstained record to receive medal and half-pay pension (as in the army), or Government employment while competent in Older Canada, pension to revert when they retired.

2. Men preferring to remain in Norland to receive free land, transport at cost, a triennial excursion to Old Canada free, and a bonus for any mines, water powers, or other public utility rendered practicable by them, as well as the usual medal and pension. With a population of educated abstainers and no need to hustle each other, save for honors, the cost of justice need be very small, and charitable institutions unnecessary. A good roads system of traction carriages would bring the benefits of civilization to the verge of eternal ice and make life tolerable if not enjoyable farther north than we suspect, and be promotive of longevity.

3. In dealing with the reckless, improvident, or criminal in our older country, we could set apart an island for each class, where useful employment and fair living would conduce to comfort, and mental improvement be given due encouragement, the genus tramp be eliminated, and the majority returned to their homes as renovated citizens.

THOS. FROOD.

Little Current, Ont.

A CONCRETE BUILDING OF INTEREST.

A concrete building of interest to Canadian engineers and architects is to be erected on Bay street, Toronto, for A. A. Allan & Co., for warehouse purposes. It is designed to be seven stories high, six of which will now be built. The walls will be of brick and the entire structural portion, including footings, columns, beams, girders, lintels, floors and roof will be of concrete reinforced with Kahn solid steel bars. The columns in the front and rear walls will be of concrete veneered with stone and brick. Structural steel is entirely eliminated.

This building is designed to carry a safe load of 225 pounds per square foot. The load on the lower columns is 350 tons. With structural steel columns and this immense load, a small fire would soon soften the steel and a serious failure result. The insurance companies, recognizing this fact, grant a preference of 35 cents per hundred, compared with steel construction.

A. A. Allan & Co. are to be congratulated on erecting this modern fireproof structure. Alfred J. Stevens, late assistant engineer on the Intercolonial Railway, has charge of the work.

SLIDING SAFETY FACTORS IN DAMS.

On page 209 will be found a table prepared by Jno. S. Fielding, C.E., M.E., to show sliding safety factors in dams. In addition to the explanation contained in the table, the following might be noted: Column four gives area of cross section in square feet; column six gives the total weight per linear foot of structure; the adhesion in column seven is the total weight multiplied by an assumed value of co-efficient of friction; the height of water in column eight is in most cases the distance from sub-base to top of spillway; column nine gives the total water pressure upon the vertical face; and column eleven gives the actual co-efficient of friction on the base under conditions assumed for weight and pressure.

Of the ancient dams, all are built curvilinear in plan with safety-factor of 2.29, 1.41, and 1.24.

Of the old dams, four are curvilinear or polygonal, and five are straight. Six have S.S.F. of over 1½, while four have less than 1½.

Of the 34 dams of late construction (from 1852 to 1892), two are dependent upon the arch plan; 15 are curvilinear, and 17 are straight. Five have a S.S.F. of over 1½, the remaining 29 having 1½ or less.

This table has been prepared to show how the S.S.F. has been greatly reduced since the introduction of the French scientific theoretical profiles and formulæ in 1852.

The above information, taken in conjunction with the fact that failures of masonry dams are of constant occurrence, and that many of them, such as the Austin, Columbus, Chambley, etc., actually slid out of their assigned positions, shows that the scientific profiles with their pretty exposition of the line of stress in a dam has lulled engineers into a sense of security that the actual condition of the safety-factor secured will not warrant.

(Mr. Fielding's paper on Dams, as read before the Engineers' Club, of Toronto, will appear in a subsequent number of the Engineer).

SLIDING SAFETY FACTORS &c

NAME OF DAM	LOCATION	DATE MATERIAL PLAN	AREA	WT PER C FT	TOTAL WEIGHT	ADHESION = T WT x by 65 COEF	HEIGHT OF WATER	WATER PRESSURE	SLIDING SAFETY FACTORS S S F	COEF OF FRICTION	REMARKS
ALMANZA	SPAIN	AMT	1496	150	224400	145860	613	117562	145860/117562 = 1.24	5238	
ELCHE	"	AMT	2615	150	392250	254963	7612	180500	254963/180500 = 1.412	4601	
ALICANTE	"	AMT	11839	150	1775850	1154302	1270	504000	1154302/504000 = 2.29	2830	
LAMPY	FRANCE	OM-	1229	150	184350	119828	5135	82400	119828/82400 = 1.454	4445	
ø PUENTES	SPAIN	OMP	16349	150	2452350	1594027	1535	740000	1594027/740000 = 2.154	3075	
VAL DE INFIERNO	"	OMP	11668	150	1750200	1137630	116.4	420500	1137630/420500 = 2.705	2402	
¤ GROS-BOIS	FRANCE	OMS	2503	150	375450	244,040	830	215280	244040/215280 = 1.133	5733	
VIOREAU	"	OMS	872	150	130800	85,020	328	33620	85020/33620 = 2.529	2570	
BOSMELEA	"	OMS	987	150	148050	96232	46.9	68900	96232/68900 = 1.396	4653	
GLOMEL	"	OMS	774	150	116100	75465	390	47530	75465/47530 = 1.587	4093	
TILLOT	"	-M-	1173	150	175,950	114367	656	134560	114367/134560 = .8491	7648	
CHAZILLY	"	-M-		THEOR^L PROFILE — SEE THEOR^L PROFILE SHEET							
ZOLA	"	OMT	3645	150	546750	355,387	119.7	447750	355387/447750 = .7937	8189	Dependence upon curved profile
NIJAR	SPAIN	OMT	5386	150	807900	525135	820	210125	525135/210125 = 2.499	2601	
LOZOYA	"	OMS	9052	150	1357,800	882570	94.0	276125	882570/276125 = 3.196	.2033	
FURENS	FRANCE	LMR	10712	150	1606800	1044420	164.0	840500	1044420/840500 = 1.242	.5230	1st scientific profile
TERNAY	"	LMR	4355	147	640,185	416120	112.7	396915	416120/396915 = 1.048	620	
✦ HABRA	ALGIERS	LMS	5584	134	748256	486366	116.8	427000	486366/427000 = 1.139	5706	
CAGLIARI	ITALY	LM-	2430	150	364500	236925	70.5	155300	236925/155300 = 1.525	.4260	
VERDON	FRANCE	LMT	863	150	129450	84142	41.17	53000	84142/53000 = 1.587	.4097	
BOYD'S CORNER	UNITED ST^S	LCS	2039	140	285460	185550	78.0	190125	185550/190125 = .9750	.6660	
BAN	FRANCE	LMR	6780	150	1,017,000	661,050	137.9	595000	661050/595000 = 1.111	.5855	
TLELAT	ALGIERS	LMS	1560	150	234000	152100	68.9	153000	152100/153000 = .9900	.6535	
GILEPPE	BELGIUM	LMR	18708	143.5	2684598	1744990	147.6	684500	1744990/684500 = 2.549	2549	
VILLAR	SPAIN	LMR	11596	143	1658228	1077848	162.3	820125	1077848/820125 = 1.314	.4945	
PAS DU RIOT	FRANCE	LMR			PROFILE BASED UPON FUREN'S						
DJIDIONIA	ALGIERS	LMS	2600	150	390,000	253500	83.67	218750	253500/218750 = 1.158	.5609	
GEELONG	AUSTRALIA	LCR	1214	143	173600	112840	60.0	112500	112840/112500 = 1.003	.6480	
POONA	INDIA	-M-	3725	150	558750	363188	97.0	294000	363188/294000 = 1.235	.5261	
TOOLSEE	"	- -	2527	150	389050	250,680	79.0	195000	250680/195000 = 1.285	5063	To Rankine's profile
HIJAR	SPAIN	LMT	8454	150	1268100	824265	141.0	621280	824265/621280 = 1.326	.4900	
GORZENTE	ITALY	LM-	5657	150	848550	551,560	121.4	460,560	551560/460560 = 1.197	.5427	
✦ BOUZEY	FRANCE	LMS	1961	150	294150	191200	75.4	180786	191200/180786 = 1.057	.6145	
ø GRAN CHEURFAS	ALGIERS	LMS	6775	150	1015250	659912	131.0	536280	659912/536280 = 1.23	.5262	
PONT	FRANCE	LMR	2755	150	413,250	268612	85.3	227,600	268612/227600 = 1.180	.5507	
HAMIZ	ALGIERS	LMS	5629	150	844350	548828	114.8	411,800	548828/411800 = 1.33	.4877	
BRIDGEPORT	UNITED ST^S	LMS	765	150	114750	74590	40.0	50000	74590/50000 = 1.49	.4357	
VYRNWY	ENGLAND	LMS	8972	160.8	1441700	937105	129.0	520031	937105/520031 = 1.802	.3607	
VINGEANNE	FRANCE	LM-			Information	Lacking					
TACHE	"	LMR			"	"					
COTATAV	"	LM-			"	"					
TYTAM	CHINA	LC-	3978	150	596700	387855	95.0	282,030	387855/282030 = 1.375	.4726	
SAN MATEO	UNITED ST^S	LCT	16660	150	2499,000	1624,350	170.0	903125	1624350/903125 = 1.79	.3614	
SODOM	"	LMS			Information	Lacking					
TANSA	INDIA	LM-	5790	150	868500	564,525	118.0	435,125	564525/435125 = 1.29	.5010	
BEAR VALLEY	UNITED ST^S	LMT	537	166.7	89520	58190	64.0	128,000	58190/128000 = .454	1.429	Dependence upon curved plan
SWEATWATER	" "	LMT	2347	164	150208	97635	90.0	253125	97635/253125 = .3857	1.655	Dependence upon curved plan
BHATGUR	INDIA	LM-			Information	Lacking					
BETWA	"	LMR			Information	Lacking					
PERIAR	"	LMS	10772	140	1508080	980252	153.0	731531	980252/731531 = 1.341	.4844	
BEETALOO	S AUSTRALIA	LCR	4810	150	721,500	468975	110.0	378125	468975/378125 = 1.24	5240	
MOUCHE	FRANCE	LMS	3300	134	442200	287430	95.0	282,030	287430/282030 = 1.02	6423	
✦ COLORADO	UNITED ST^S	LMS	2300	—	322000	209300	70.0	153,125	209300/153125 = 1.366	.4755	
BUTTE CITY	" "	LCT			Profile	Lacking					
TITICUS	" "	LMS	5209	150	781,350	507880	135.0	569530	507880/569530 = .891	.7255	
REMSCHEID	GERMANY	LMT			Profile	Lacking					
LAGRANGE	UNITED ST^S	LMT			"	"					
EINSIEDEL	GERMANY	LMR			"	"					
HEMMET	UNITED ST^S	LMT	7500	150	1125000	731250	135.5	583765	731250/583765 = 1.25	5197	
WIGWAM	" "	LMS	2870	150	430500	279825	90	253125	279825/253125 = 1.10	.5877	
NEW CROTON	" "	LMS	28400	150	4,260,000	2769000	224	1568,000	2769000/1568000 = 1.76	3650	
ASSUAN	EGYPT	LMS	3826	150	573900	373,000	75.5	178,140	373000/178140 = 2.09	.3104	

EXPLANATION OF SYMBOLS USED ABOVE

A = ancient or previous date to 1600
O = old " " 1852
L = modern = since " of 1852
S = straight on Plan
P = Polygonal "
R = Curved " to large radius
T = " " " small "
M = Masonry
C = Concrete
✦ = Failed
¤ = " in part
ø = showed weakness

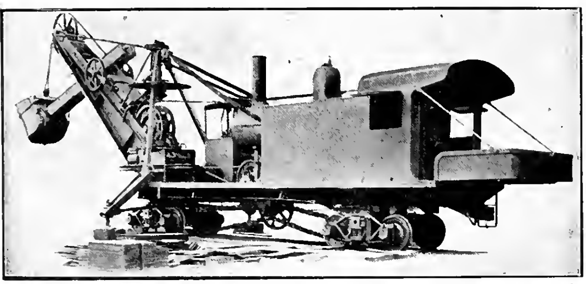
THE MARGIN of SAFETY is shown graphically in col under Remarks.
The total length of the bar equals the safety-factor (S.S.F.)
The light portion " " " " pressure
The Heavy " " " " margin of safety i.e. the excess strength over and above the pressure

In LAST COL^N ARE ALSO GIVEN SECTIONS OF DAMS
THOSE IN BLACK ARE DEPENDENT UPON ARCHED PLAN
" HATCHED " CURVED NEAR TO SHORT RADIUS " "
" SLIGHTLY " " " " LARGE "
THOSE NOT HATCHED AT ALL ARE STRAIGHT ON PLAN S

THE ROBINSON WIRE ROPE STEAM SHOVEL.

The great expansion that has taken place in power and capacity of locomotives and rolling stock of railways now finds its counterpart in the necessity for corresponding increase in power and capacity of the steam shovel. Ten years ago the standard railway shovel weighed 35 tons and carried a dipper of 1½ cubic yards' capacity; now shovels are in use which weigh 90 tons and carry a dipper of 5 cubic yards' capacity. Mere weight and size, however, do not give efficiency in service. Great weight, which is necessary in a locomotive, is a disadvantage in a steam shovel, because it not only makes it cumbersome and difficult to hold up on temporary rails and soft ground, but makes it slow of movement.

The steam shovel illustrated herewith is a new machine which is being built in Canada by the Locomotive and Machine Co., of Montreal, and in the United States by the American Locomotive Co. from the designs of A. W. Robinson, C.E., Montreal. This machine is the result of many years' experience in the design and operation of steam shovels and dredging machines, and it includes all the desirable features of the best modern practice in shovel-building. The steam shovel has become an indispensable machine to railroad companies and contractors engaged in construction work, and the present machine has been brought out to meet the demand for a high-class shovel of greater speed, power and capacity. This shovel is built on locomotive lines, and the quality of the design and workmanship throughout is fully up to the best class of locomotive construction. This has not been the case hitherto with shovels built by manufacturing companies, whose aim has been more to keep the cost down to the lowest possible notch than to produce the best machine that can be built. The work which the steam shovel is called upon to do is probably the most severe and exacting of any mechanical appliance and as a rule it is handled by a class of men who are not careful engineers, and whose only object is to get the most work out of the machine regardless of consequences. A good shovel must be quick in its movements, easily handled, and very strong in all its working parts, and constructed so that it cannot get out of order with any kind of handling.



The Robinson wire-rope shovel has been designed to fulfil the following requirements, which are primarily intended to cover the conditions of modern railway work:

1. Simplicity of design with direct strain, and few and strong parts that will not break or easily get out of order. 2. The highest possible speed and power consistent with safe and effective working. 3. Avoidance of wear and breakage of chains and sheaves. 4. Moderate weight. 5. Better and more efficient boiler for easy steaming and economy of fuel. 6. The employment throughout of the highest quality of design, materials and workmanship, and fully equal to the best locomotive practice.

These and many other points will commend themselves to practical men. The shovel illustrated is one in use by the New York Central and Hudson River Railroad. It is a Class 38-16-2½ machine. This means a shovel having a pull upon the dipper of 38,000 pounds, a clear height of lift of 16 feet, and a capacity of dipper of 2½ cubic yards. This system of numbering expresses at once any combination of these three elements in a shovel, and is more systematic than the use of arbitrary numbers or letters of the alphabet commonly employed, which do not mean anything.

The distinguishing feature of this shovel is the direct wire-rope hoist. In an ordinary machine a chain is used for hoisting which passes over six sheaves. Few persons appreciate the great loss in wear and tear to heavy chain used in high-speed hoisting. This loss amounts to at least 40 per cent, whereas the loss in the case of direct wire rope hoist does not exceed 10 per cent. In the Robinson shovel there is but a single sheave used for hoisting, and this of very large size. This single sheave, besides reducing friction, has the very important advantage of increasing the angle of lead to the bucket. This is a most important feature, as it determines the digging efficiency of the machine. It is of but little use to exert a heavy pull upon the dipper by means of the hoisting chains if the angle formed by these chains on the dipper handle is so acute as to produce but little effect. In this shovel this angle is increased to such an extent that the digging effect is practically doubled. In other words, the same work can be done at higher speed and greater power and with a smaller expenditure of steam and less strain upon the machine.

The construction of this shovel is such that about four to six feet more height of lift can be obtained with the same length of boom as compared with other shovels, and it is possible to construct machines with a clear height of lift of twenty feet which will work at fully as high speed as the lower lift machines of the old type. This is a valuable feature in the reconstruction of existing railroads, of which so much is being done at the present time to reduce the grades.

Referring to the illustration, it will be seen that the hoisting engines are incorporated in the base of the boom, so that the whole hoisting machinery revolves together. This leaves more room on the car for the boiler, which is made unusually long and of first-class locomotive construction. The weak point of most shovels is in the boiler, which is too small and too cheap for the work. The boiler on these shovels is 21 feet long, and built for a working pressure of 150 lbs. per square inch. For ordinary purposes the shovel is not enclosed by the usual box-car construction. This looks well when new, but in a few weeks becomes dilapidated owing to the severe work. In the Robinson shovel ample protection for the men is afforded, and everything is covered that needs to be covered and the rest is left off. There is no woodwork whatever about the machine; therefore it is practically indestructible. The speed of the machine is such that six dipper loads per minute can be made and maintained by the operator without difficulty or fatigue.

The Canadian Locomotive and Machine Co., Montreal, are building four of these shovels at their works at Longue Pointe, and intend to make up a number for stock.

MARINE NEWS.

The foundry building at the yard of the Collingwood Ship Building Co., Collingwood, Ont., is to be completed at once.

The Dominion Government is preparing to have a new steamer constructed for the quarantine service at Halifax, N.S.

The Allan Line officials have made arrangements with a New York wrecking company to attempt to float the steamer Hibernian, stranded near Codroy, N.F.

The three-masted schooner, Ida Oleson, recently lying at Alpena, Mich., has been bought by Capt. George Dunn, of Owen Sound, Ont., for the lumber trade on Georgian Bay.

A new steamer, named the Annie, for towing and general service on the Newfoundland coast, has been launched at Fogo, N.F. She is fitted with two sets of compound engines, 7½-in. and 13-in. cylinders, by 12-in. stroke, and will make 11 knots an hour.

The City of Windsor will be commanded by Capt. P. M. Campbell, and A. B. Pratt, lately with the Northern Navigation Co., will be purser. The steamer will run from Collingwood to Sault Ste. Marie, Ont.

Owing to the frequent delays of steamers at the western gap at Toronto, by reason of an inefficient foghorn service, the Dominion Government has decided to put up a more modern and more powerful horn.

The Dominion Parliament has under consideration a bill providing for the inspection of the machinery and equipment of boats propelled by gas, fluid, naphtha, electricity or any other mechanical or chemical power.

The steamer Urania, formerly run by the Lake Erie & Detroit River Railway Co., between Rondeau and Port Stanley, Ont., and Cleveland, O., has been sold to Windsor, Ont., parties, who propose to replace her on her old route.

The new steel dredge built at Lilloet, to meet the requirements of gold dredging on a swiftly flowing river, will soon begin operating on the Fraser river bars. This dredge is the largest of its kind in Canada, and was constructed at a cost of $87,000.

The Union Steamship Co. has just received a tug 81 ft. 6 in. in length, 18 ft. beam, fitted with compound engines, 13 and 26-in. cylinders by 18-in. stroke, built at the Cates yard, False Creek, Vancouver, B.C. The engines were imported from Scotland.

A company has been given a Dominion charter to purchase the steamer Richard and other vessels, and to engage in a general navigation business. The capital is $40,000, and the offices are at North Sydney, N.S. W. Hackett, North Sydney, is one of the promoters.

The new wharf under construction at Victoria, B.C., for the Canadian Pacific Railway, will be 430 ft. long by 90 ft. wide, and will have accommodation for six steamers alongside. There will be a shed 255 ft. by 60 ft. wide on the wharf for freight and passenger accommodations.

The Canadian Pacific Railway Co.'s steamer Princess May has been fined $2,600 for carrying thirteen passengers from Ketchikan, Alaska, to Vancouver, B.C., they being destined for Seattle, Wash., to which point they were subsequently ticketed by the C.P.R. by its steamer from Victoria or by rail.

The proposal of the Dominion Government to place the harbors at Port Arthur and Fort William, Ont., under the control of the harbor commission, is being opposed by the Dominion Marine Association, on the ground that the rates which the commissions will be empowered to charge will handicap the development of the trade.

The Department of Marine is conducting some experiments near Sorel, Que., with an electrical device for guiding steamers in narrow channels. Parallel lines of cables have been laid in the river, but not in the ship channel, for a length of two miles, in connection with the project. A report will be submitted to the department on the experiments.

Capt. McLaughlin, an old-time mariner, died in Toronto recently, aged eighty years. He was master, among others, of the Perseverance, Enterprise, Elizabeth, Victory, Mary Caroline, Mary Taylor, Odd Fellow, Alice Grover, J. A. Torrance and Lacoucier, whose names and routes old mariners will recall.

A bill providing for harmonizing the rules of navigation with those of the United States has been passed by the Dominion Parliament. The Act authorizes the Governor-in-Council to proclaim the new regulations as soon as they have been examined by the authorities. This question was one brought under the notice of the Government by the Dominion Marine Association.

A charter has been granted by the Dominion Government to Revallion Bros. (Limited), to take over the trading business of Revallion Freres, of Paris, London, and elsewhere. The company has trading stations at Quebec, Edmonton, on the shores of Hudson's Bay, etc., and its property includes a couple of steamers. The capital is fixed at $5,404,000, and P. D'Anigeaux, of Quebec, is named as the agent of the company in Canada.

The St. John, N.B., Dock Co. is negotiating with a contractor for the construction of the dry dock at that port, and expects to have the details all completed early in July.

The C.P.R. is considering plans for a new passenger steamer for its service on Kootenay Lake, B.C. It has just completed a new 15-car freight barge for Kootenay Lake.

The Richelieu & Ontario Navigation Co. have decided to raise the wreck of the Canada, and reconstruct it at its shops, Sorel, Que., at an estimated cost of $80,000.

The Quebec Steamship Company intend to inaugurate a new steamship line between St. Lawrence ports and North Sydney. The steamer St. Lawrence will be placed at once on this route.

The Arctic exploration steamer, Gauss, recently purchased by the Dominion Government from Germany, arrived in Quebec, June 13th, under Capt. Bernier, after a thirty-six days' trip from Bremerhaven.

The Dominion Government has under construction, at Selkirk, Man., the hull of a new steamer to replace the Victoria on Lake Winnipeg. The machinery from the old steamer will be placed in the new hull.

In reply to a question in the Senate, information was given that the Government intend building two ice-breaker vessels for use on the St. Lawrence. One is to be ready by September 1st. Canadian tenders were not received, as the firms could not have the vessels ready in time. Ice-breakers for the Great Lakes will be built in Canada.

The B. C. Foundry and Engineering Works, Limited, is erecting at Esquimalt a foundry specially adapted for marine work. The main building is about 90 feet by 50 feet. The plant is to be run by electricity, the power being obtained from Goldstream. Stevens & Hawkins are supplying the electrical plant for the works. The foundry equipment is being supplied through the Seabrook Machine Works.

The Dominion Government, by a special Act, has authorized the importation into Canada of the patented marine turbine machinery of the steamer Turbinia, as well as in kindred vessels up to the end of the year 1905, so as not to affect the validity of the Parsons steam turbine patents. Ridout & Maybee, of Toronto, were the patent solicitors employed in procuring the passage of the Act.

It is probable that a steel shipbuilding plant will be established at Dartmouth, on Halifax harbor. Halifax, Dartmouth, and the Nova Scotia Government have offered subsidies and bonuses amounting to to $300,000. The promoters recently asked the Federal Government for a bonus on the amount of tonnage built at Halifax. Ald. W. S. Rogers, J. E. de Wolfe, president of the Board of Trade; James Hall, representative of the Furness-Withy Line, and B. F. Pearson, M.P.P., all of Halifax, are interested.

The Richelieu & Ontario Navigation Co.'s steamer Canada was sunk in the St. Lawrence river, off Sorel, June 12th, after having been in collision with the Dominion Coal Co.'s steamer, Cape Breton. Five lives were lost. The Canada was a side-wheel steamer, built at Sorel, Que., 248 ft. long, 31.2 ft. beam and 10.8 depth of hold. She was 1,708 tons gross, and 962 tons register, and was licensed to carry 600 passengers. The Canada was formerly employed on the Quebec-Saguenay, but for the last year or two has been running between Montreal and Quebec. Her value is placed at $100,000, but she was uninsured.

In the absence of any big grain shipments from the West, the Canadian Pacific Railway Atlantic Steamship Co. have just closed an important contract, the first of its kind ever made in Canada, which calls for the shipment of 15,000 tons of lead ore from the Kootenay district of British Columbia to England. The company, in this way, will be able to fill up a great deal of space occupied in other seasons by grain, and will be able to bring the tonnage well up to the same level as last year. The C.P.R. have also made contracts for the shipment of large quantities of copper ore from the Sudbury districts.

* * *

Richardson Bros., of Kingston, are building at Picton, Ont., the largest canning factory in Canada. It is to be ready for the fruit and vegetable season this year.

NEW ONTARIO NOTES.

The Webbwood gold mine, in Shakespeare township, is being developed.

The Massey Station copper mine is installing an Elmore oil concentration plant for treating their ore.

Two water powers are being improved in the neighborhood of Sudbury for the purpose of supplying that town with electricity.

The mines now being operated in the nickel field are Creighton and Copper Cliff, belonging to the Canadian Copper Co., and the North Star, operated by the Mond Nickel Co. The west smelter, belonging to the Copper Co., was burned down a few days ago, but the new smelting works are nearing completion. This plant is thoroughly modern and on a large scale.

The Soo industries are at present running, as they have been for four or five months past, under the expiring company, that is, the pulp mill, veneer mill, sawmill, ferries, street railway, etc., are in continuous operation. The Lake Superior Corporation are making arrangements to open the steel works and other industries, and it is expected that all the works will be in operation in a very short time.

The Ontario Government has the following parties exploring New Ontario this summer: Under J. G. McMillan, a party is examining the geology and resources north and northwest of Lake Abitibi; a party, under J. M. Bell, is exploring the Michipicoten iron range; Dr. A. P. Coleman, with assistants, is examining the Sudbury nickel range; and Prof. W. G. Miller, Provincial Geologist, is examining discoveries of cobalt, nickel, and silver, in the neighborhood of Haileybury. Mr Bell reports having left the C.P.R. at Missinibie Station, whence he followed the chain of lakes to the Magpie river, and that he was able to make an excellent section through an entirely unexplored country. He is now at a point east of the Pacaswa river, and so far has encountered and examined three areas of iron-bearing rocks. One of these is at McDougall's claim, fourteen miles north of the mouth of the Pacaswa, where there is a wide band of magnetite in hornblende schists. The ore body is about 200 feet by 350 feet in side, and appears to be a valuable property. The second area is two miles north of the Pacaswa and extends for over a quarter of a mile, but it does not seem to be of great value. The third area is on the same river and resembles in many ways that first described. Mr. Bell says he has encountered a number of quartz veins, of which he has taken samples for subsequent analysis.

NEWFOUNDLAND'S MINERAL RESOURCES.

We have before us the report of the Newfoundland Geological Survey for the calendar year 1903. The report is made by James P. Howley, F.G.S., and while confined within short compass, it contains a comprehensive review of the mining industries of the Island colony.

The total value of raw mineral substances raised in the island in 1903 was $1,269,805, an increase of $52,119 over 1902, and this in the face of severe depression in the iron industry, which resulted in a great falling off in the shipments of iron ore from Bell Island last year. The amount of iron ore raised last year was 588,795 tons. The copper production was good, reaching 87,790 tons, an excess of 13,182 over last year.

Pyrites, for the manufacture of sulphuric acid, shows a production of 42,000 tons, an increase of 16,000 tons over 1902. A large deposit of pyrite at Rowsell's Harbor, held under option by the Dominion Iron Co., has not yet been exploited, but it is expected that it will be producing this season.

Barite is becoming important, showing a production last year of 4,300 tons.

$63,000 was the value of the roofing slate produced in the island in 1903. New machinery for the more economic treatment of slate has been installed, and this industry is one rapidly growing in importance. Several new deposits of slate are being exploited, and will probably become producers in a short time. A Welsh slate expert declares Newfoundland slate to be of superior excellence, and as there are many slate deposits in various parts of the island, the outlook is very bright.

The brick industry showed a slight decrease, owing to unfavorable weather, and the destruction of an important plant by fire. The quality, however, is much improved, and the demand for the local product is on the increase, so Newfoundland is looking forward to the time when the importation of brick will be unnecessary.

Gold mining commenced during 1903. Gold exists, not only in the baser metals, but in quartz-leads, in free state, and at least in one instance, in the form of placer deposit. About $3,000 was the value of the total production last year.

Operations in the petroleum industry have not yet reached the productive stage, but the results are not at all discouraging, and it is now considered that the establishment of a refinery is fully warranted.

The chromite deposits have not been developed, but a mining company, at Benoit Brook, will start operations as soon as they complete a tramway now under construction for ore transportation.

Considerable attention was given last year to talc deposits, but the work of development has been retarded owing to litigation.

As nearly as can be ascertained, the total number of persons employed in mining operations is 2,067, over 800 of these being engaged in iron mining, and more than 600 in copper mining.

The mineral output of the colony, when reduced to commercial products, is worth, approximately, $8,000,000, while the raising and exporting of the crude minerals brings in a modicum probably not exceeding $350,000. Hence Mr. Howley strongly urges the Government to encourage the establishment of smelters and refineries in order to be able to export finished products.

RAILWAY NOTES.

A by-law to give $20,000 bonus to the Ontario Electric Railway was defeated in Clark township.

The Grand Trunk Railway has under consideration a project to enlarge its car and motive works at Point St. Charles.

The first through train for Victoria Falls over the Cape-to-Cairo Railroad, left Cape Town on June 22nd, amid enthusiastic demonstrations.

The G.T.R. shops, at Stratford, are to be enlarged at a cost of between $100,000 and $200,000. A boiler shop will be erected, 169 by 120 feet, a tender shop, 326 by 102 feet, a carpenter shop, 100 by 63 feet, and a brass foundry, 75 by 40 feet. The blacksmith department will also be enlarged, and an addition 175 feet long made to the erecting shop.

Arrangements have been completed whereby the investment of between a quarter and a half million dollars for a big tourist hotel in Victoria by the C.P.R. will be supplemented by the expenditure of another hundred thousand to complete an entire square. By the new arrangement the city cedes to the C.P.R. the whole of the reclaimed James' Bay flats and the esplanade fronting on the harbor.

The telegrophone is being installed on the C.P.R. system around Ottawa. A car on each train will be equipped with the telegrophone, and when it is desired to communicate from a point where there is no telegraph instrument all that is necessary is to make a connection with the telegraph wire and use it to transmit emergent telephone messages. The uses of the wire for 'phone and telegraph do not conflict.

St. Catharines has granted $20,000 aid to the Niagara, Queenston & St. Catharines Electric Railway. The company, which is incorporated under an Act of the Dominion Parliament, will begin construction early in the fall. The line extends from St. Catharines through the fruit districts of the Townships of Grantham and Niagara, to Niagara-on-

the-Lake, thence along the bank of the Niagara river to Queenston, and from there to St. Catharines, forming a belt line of thirty miles. Among those interested in the railway are: R. S. D. Hartrick, of Pittsburg, and J. N. McKendry, W. B. Rogers, and Herbert L. Dunn, of Toronto.

The Guelph Street Railway has installed a 150-h.p. storage battery, which is giving great satisfaction.

The Edmonton Street Railway Co. is obtaining a charter which gives it power to deal in electricity and engage in coal mining.

The Dominion Government intends to purchase the Canada Eastern Railway, New Brunswick, for $800,000, to be operated as part of the Intercolonial system.

According to the St. John Sun, the Shore Line will change their terminus from Carleton to St. John, and intend doing a through business from that city to United States points. This will necessitate a bridge across the St. Croix river.

It is stated that the Canadian Pacific is preparing to erect the largest and most complete grain elevator in the world at Fort William, to double the capacity of its coal docks, and to enlarge its freight sheds at that point within the next eighteen months. Construction on some of these improvements will be begun this year.

The Ontario Government has passed an order-in-council preparatory to guaranteeing the bonds of the James' Bay Railway Company to the extent of $20,000 per mile from Toronto to Sudbury. The provincial guarantee will date from the completion of the road, and will run for a period not exceeding thirty years, at the rate of 3½ per cent. per annum.

It is said the Gand Trunk Railway Company have acquired an option on a controlling interest in the Hamilton, Grimsby and Beamsville Electric Railway, and that the electric railway may be turned over to the G.T.R. Company in the course of a month. The proposition is to run the electric line as an adjunct of the steam railway. For several years the H., G. & B. have been doing a big business in the fruit line in connection with the C.P.R. and the Dominion Express Company, and it is understood that all this fruit business will be diverted to the G.T.R. and Canadian Express Company. The report is that the G.T.R. Company are to pay $200 a share for the capital stock, which was recently raised from $200,000 to $300,000, the extra $100,000 being taken up at par. When the Vineland extension was built the bonded indebtedness was increased from $85,000 to $150,000. Hamilton gave the H., G. & B. Company a bonus of $25,000 on the understanding that at any time the present company or its successors failed to operate the line as a passenger line the bonus was to be returned.

NOTES OF THE CONVENTION.

The Canadian Westinghouse Co. had a fine exhibit in a cafe on the ground floor of the Royal Hotel. Switches, transformers, lamps, controllers, etc., made an interesting display, while a side table was loaded with an abundance of information in the shape of catalogues and circulars.

Prominent in the main corridor were the exhibits of clay conduits from the Field-Foulks Co., of New York, and of insulators from C. S. Knowles, Boston.

Allis-Chalmers-Bullock, Limited, of Montreal, issued a neat and very convenient register of delegates, which made identification easy. In order to keep up to date, three or four editions of the register were issued during the convention.

Mr. Culverwell, of Peterboro, did considerable advertising for the Trent Valley Canal, "the only grain route whose competition is feared in the United States."

The generosity of the Cataract Co., in honoring the convention buttons, as passes on the Hamilton street cars, was much appreciated by the Association.

The Sunbeam Incandescent Lamp Co., of Canada, Limited, distributed a neat souvenir in the form of a perpetual pencil made by the American Lead Pencil Company. Mr. Edwin Irving, general manager in Canada for the Sunbeam Co., will be pleased to mail a pen[illegible] to any central station manager or other interested party, on application to him at the McKinnon Building, Toronto.

The registration at the convention was 156, twenty-two more than at any previous convention.

Regret was expressed at the absence of K. B. Thornton, and A. A. Wright, M.P., the former through illness, and the latter on account of parliamentary duties.

Frederic Nicholls was present at the convention, on Wednesday, returning to Toronto that evening on his new yacht, The Tranquilo, which is said to be one of the best on the lake.

A parlor in the hotel was devoted to a display by the Canadian General Electric Co. Tastefully arranged on a large table were samples of artistic electrical apparatus, such as lamps, brackets, push buttons, heaters, etc., etc. Literature descriptive of C.G.E. products was at hand, and an obliging attendant distributed souvenirs to visitors.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

About two hundred members of the Institution of Civil Engineers of Great Britain propose to visit Canada and the States during the coming autumn. During their stay of a week in Canada, they will be entertained by the Canadian Society of Civil Engineers. The visitors are expected to arrive in Montreal about September 20th. The 20th will be devoted to a drive in and around Montreal, the 21st to a trip to the Soulanges Canal, the 22nd to a trip to Ottawa, 23rd trip to Quebec, 24th to Toronto, and on Monday, 26th, the visitors will be taken to Niagara Falls. From here they will go to Chicago and then on to the World's Fair at St. Louis. These are the main features of the Canadian programme, the details of which are now being arranged by a committee of the society.

INSTITUTE OF ELECTRICAL ENGINEERS.

Under the presidency of J. A. Kammerer, the Canadian branch of the American Institute of Electrical Engineers has made healthy progress. The parent organization came into existence in 1884 with a membership of 100. It now has 3,000 members, among whom are many of the world's foremost electricians. The object of this institution is to advance electricity as a science, and in pursuing this high aim it has given to the world a mass of valuable technical literature. Its meetings and conventions have been free from the influence of the supply man and others, who are "out for business."

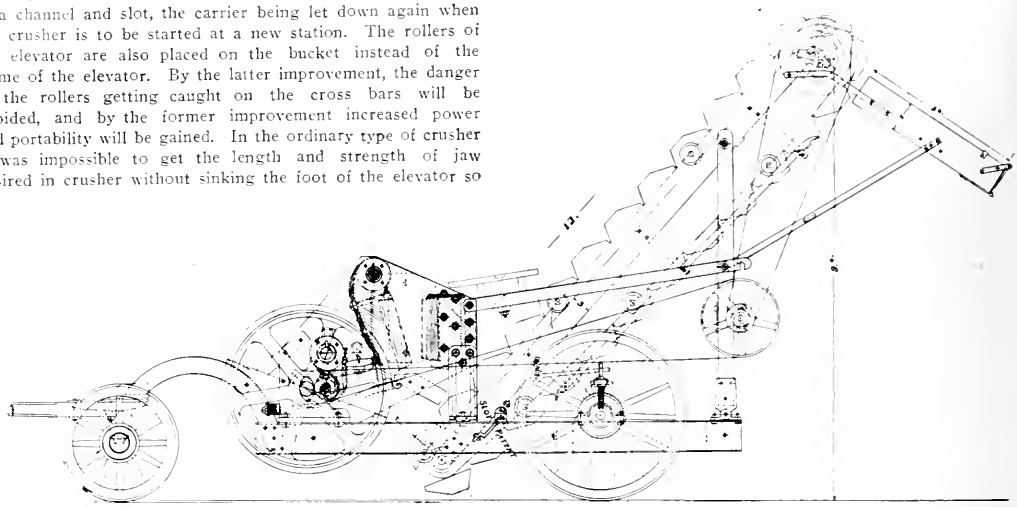
The Canadian branch has the benefit of copies of papers read before the parent institution with reports of discussions; but apart from this, some instructive papers have been presented at the meetings in Toronto during the past session. Among these papers may be mentioned one on "Transformers," by Prof. Rosebrugh, of the School of Practical Science, Toronto; one on the "Storage Battery," by E. B. Walker; one on the Toronto and Niagara Power Co.'s works at Niagara Falls, by K. L. Aitken, of Toronto, the two last named being repeated before the Canadian Electrical Association. Another paper on the Soulanges Canal electrical equipment, by J. Kynoch, chief engineer of the Canadian General Electric Co., appears in another part of this issue. The last meeting of the session was held on the 10th June in the rooms of the Engineers' Club, of Toronto, when Mr. Aitken's paper was read and illustrated by lantern slides. The meeting, which was well attended, was concluded by a supper, presided over by Mr. Kammerer. The following officers have been elected for the ensuing year: Chairman, Prof. T. R. Rosebrugh; vice-chairman, H. A. Moore; secretary, R. T. Mackeen (re-elected); executive committee, R. G. Black, J. A. Kammerer, and K. L. Aitken.

The meetings of the branch will be resumed at the rooms

of the Engineers' Club, on the evening of October 7th. Information relating to membership may be obtained by addressing the secretary, R. T. Mackeen, electrical engineer, Canadian General Electric Co., Toronto.

IMPROVED ROCK CRUSHER.

The cut below shows an improved rock crusher, placed on the market by the Good Roads Machinery Co, of Hamilton. When the crusher is to be moved from its working station, the carrier is lifted quite clear of the road by means of a channel and slot, the carrier being let down again when the crusher is to be started at a new station. The rollers of the elevator are also placed on the bucket instead of the frame of the elevator. By the latter improvement, the danger of the rollers getting caught on the cross bars will be avoided, and by the former improvement increased power and portability will be gained. In the ordinary type of crusher it was impossible to get the length and strength of jaw desired in crusher without sinking the foot of the elevator so low as to risk damaging the machine when moving it from place to place. By this simple shifting device, the jaws can be made long and strong enough for any service, and yet permit the elevator to be raised clear of the road when travelling. This improvement is the subject of a patent.



PERSONAL.

Mr. John Coom, chief engineer of the Government Railways of New Zealand, spent a couple of days in Toronto recently, on his way home to the Old Country. He will not return to New Zealand until December.

Among the King's Birthday honors, distributed on June 24th, A. Gobeil, deputy Minister of Public Works, and David Pottinger, general manager, Government Railways, were made Companions of the Imperial Service Order.

Arthur W. Holmes has been appointed by the Ontario Government to the vacancy caused by the retirement of Jas. R. Brown, thus completing the staff of factory inspectors. Mr. Holmes has been a member of the executive of the International Machinists' Union for some years.

Lieut. Gordon Tyndale Jennings, Reserve of Engineer officers, who graduated at the Royal Military College of Canada, in 1902, and subsequently obtained the degree of B.Sc. in Civil Engineering at McGill University, has returned to Toronto, and is engaged in his profession, with his father, W. T. Jennings, M.I.C.E.

T. S. Rubidge, chief engineer of the St. Lawrence canals, died at his residence, Mountain Place, Cornwall, aged about 84 years. The deceased gentleman was a native of England, but spent most of his life in Canada, being in the employ of the Government since 1844. He was engaged on the construction of the Iroquois Canal, a section of the Intercolonial, and other public works.

The Nova Scotia Government recently appointed C. R. Coutlee, of Aylmer, Que., good roads instructor. Mr. Coutlee is a member of the Canadian Society of Civil Engineers, and is under forty years of age. He was educated at the Royal Military College, Kingston, graduating fifteen years ago. Since then he has been employed on important works from Montreal to Vancouver, and is now carrying on a general engineering practice at Vancouver. He is regarded as an expert on highway construction.

Fred. B. Fetherstonhaugh, head of the firm of Fetherstonhaugh & Co., patent barristers, Toronto, has associated with him in charge of the Montreal office, Albert F. Nathan, late examiner in the United States Patent Office, Washington. Mr. Nathan is a member of the Bar of the Supreme Court and of the Court of Appeals, D.C., and holds degrees from the Massachusetts Institute of Technology, National University, and Columbian University, besides having had practical experience in electrical, mechanical, and chemical industries.

Geo. A. Mountain, chief engineer of the Canada Atlantic, has, by an order-in-council, been appointed engineer to the Railway Commission, created by the Dominion Parliament last session, and of which Hon. A. G. Blair is chairman. Mr. Mountain was born at Quebec in 1860, and began his professional career in the office of the City Engineer. He was engaged on surveys for the Newfoundland Railway and the Quebec and Lake St. John Railway. As assistant engineer on the Canada Atlantic, he superintended the construction of the Ottawa, Arnprior and Parry Sound division, and he became chief engineer of the system in 1890. Mr. Mountain is an active member of the council of the Canadian Society of Civil Engineers. In his new position he will be expert adviser to the Railway Commission.

The suit of Peter Lyall against the Glen Falls Portland Cement Co., for $38,000 damages for failure to supply cement of the quality contracted for, has been settled by jury trial in Montreal. The verdict is in favor of plaintiff for $10,393.86. The trial lasted three weeks. The cement in question was for the Chambly dam, the failure of which was described in the Engineer at the time.

—The problem of obtaining nitrogen from the atmosphere for fertilizing the land appears to have been solved, at least from a scientific point of view, by Doctor Erlwein, a German experimenter. His method is first to separate the nitrogen from oxygen by passing an air-current over red-hot copper, when the oxygen combines with the metal, leaving the nitrogen free. Then the nitrogen is caused to combine in an electric furnace with a mixture of powdered charcoal and lime. The product is a black substance suitable to be spread on the land, and possessing the fertilizing properties of Chile saltpeter and potassium nitrate. It remains to be demonstrated that the new ferilizer can be produced on an extensive scale and at an economical cost.

The Canadian Engineer

VOL. XI.—NO. 8. TORONTO AND MONTREAL, AUGUST, 1904. PRICE 10 CENTS / $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY, MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada, Great Britain and the United States, $1.00 per year, foreign, 6s. Advertising rates on application.

OFFICES—18 Court St. Toronto; and Fraser Building, Montreal.
Toronto Telephone, Main **4310.** **Montreal Telephone,** Main **2589.**
BIGGAR-SAMUEL, LIMITED, Publishers,

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 15th of the preceding month or if proof is desired, 4 days earlier.

CONTENTS OF THIS NUMBER:

NEWFOUNDLAND AND CANADA.

It is the green hill far away that charms us most. The great things in prospect are more alluring than the modest possibilities of the moment. This disposition to look beyond—and often to overlook—the facts and duties immediately at hand, seems to be prevalent in trade as well as in philosophy. We find our neighbor the United States spending hundreds of thousands of dollars and publishing volumes of reports with the object of cultivating trade and of introducing United States manufacturers into South America and other parts of the world more distant and more alien, while Canada its nearest neighbor buys more United States goods than the whole continent of South America. Canada in her turn has commercial agents in Australia, New Zealand, South Africa, the West Indies, Norway and Sweden, and is establishing direct commercial relations with other countries more or less remote, while here at our Atlantic gateway is Newfoundland, one of the very best customers this Dominion has ever had, with no direct commercial representation on our part, and with a record of diplomatic dealings which has been no credit to this country. Indeed, it is questionable if a more criminal blunder was ever committed in the political history of Canada, than that through which the negotiations opened up some years ago by the Newfoundland delegates for the entry of the Island into the Canadian confederation were broken off through the haggling over a matter of $5,000,000. But it must be confessed that the halting and narrow spirit which has characterized our relations with Newfoundland has not been peculiar to any political party or period, but has been because of our immature notions of Imperial relationship. We had not yet learned to think of Newfoundland as our nearest sister in the Imperial family to whom we owed the duty of a little help and counsel. We were all absorbed in our own selfish concerns, and as is the case in individual life with extremely selfish people, we are reaping commercially what we sowed politically and morally.

We have nothing to say against the establishment of commercial agents in the British Colonies and other parts of the world, but these steps should have been taken and the weightier matter of relations with our nearest sister colony not neglected. Our United States neighbors at all events have not neglected their commercial opportunities—as they have active commercial consuls there—and the results will be seen in the figures which follow.

In 1886, out of a total trade of over $7,000,000, Newfoundland did $3,123,716 with Great Britain, $2,132,850 with Canada, and $1,961,263 with the United States. Of these totals the island's imports were as follows: From Great Britain, $1,911,001, from Canada $1,937,605, from the United States $1,672,810. In 1893 Newfoundland's imports from Great Britain stood at $2,680,853, from Canada at $2,886,001, and from the United States at $1,665,227. Coming down to 1903 we find a remarkable change in the positions of the three countries, for in this year the island imported $2,143,404 from Great Britain, $2,800,807 from Canada, and $2,920,914 from the United States. This out of a grand total import of $8,479,044, and a grand total export of $9,070,504 from the island.

Taking the export side of the account we find that Newfoundland shipped goods in 1886 to the value of $195,245 to Canada, $1,212,715 to Great Britain, and $288,453 to the United States; but in 1903 she exported the following amounts: $2,173,000 to Great Britain, $1,102,650 to Canada, and $1,357,031 to the United States.

The reader will see that the United States has in these ten years gained relatively at the expense of both Canada and the Mother Country. Stated in terms of 100,000s., the United States has gained from 16 to 20, Great Britain has fallen from 26 to 21, and Canada has stood still. It must be remembered that the general foreign trade of Canada has more than doubled in the ten years referred to. There is a

startling significance in these figures, and if our statesmen are not awake to the meaning of the change our commercal men and manufacturers ought to use the speaking trumpet.

As a matter of interest to merchants and manufacturers, we may note some of the items in which the three countries named still lead in the trade with Newfoundland. Canada led in exports there in the following lines: Live stock, fruit, belting, biscuits, bricks, brushes, butter and cheese, grain, cabinet ware, canoes, carriages, casks, eggs, flour, ships' dories, hair cloth, harness, hay, iron bridges, rough leather and leather goods, ships' masts, oiled clothing, picture frames, ploughs, saws, tinware, and wooden ware. The United States has now got first place in bicycles, blocks (ship) candles, canvas, certain lines of wagons and wagon and carriage bodies, wheelbarrows, spokes, springs, clocks and watches, feathers, boot and shoe findings, flag stones, groceries, hardware in certain lines, rubber goods, iron and steel bars, sole leather, locomotives, several classes of lumber, machinery under each of the three classes, dutiable at 35, 25 and 10 per cent. respectively, nails, of the class dutiable at 35 and 25 per cent., nets, staves and headings, window shades; Great Britain holds first position still in textile fabrics generally; cement, several lines of hardware, chemicals, china and earthenware, cordage, drain pipes, explosives, fancy goods, hats and caps, hoop iron, metal tubes, nails dutiable at 10 per cent, paints, wall papers, pianos, ready-made clothing, small wares, spirits and liquors, shaftings, some classes of steel, etc.

Writing on the development of United States trade, a special correspondent of the Toronto Globe who recently visited the island, says: "The alarming increase in the trade with the United States led me to a special investigation among the business men of St. John's. I was told that it was due largely to neglect on the part of Canadians and enterprise on the part of Americans. The United States Consul in St. John's, Mr. J. O. Cornelius, has, since his appointment some years ago, been indefatigable in working up trade between his country and Newfoundland. He is ever on the alert for new avenues of commerce, and, the better to do so he is constantly in communication with sub-Consuls in every fishing settlement throughout the island. He studies the requirements of the people, and watches, lynx-eyed, for new developments in the colony. Immediately he discovers an opening for trade he corresponds with firms in the United States. His reports to the Washington Government are frequent and complete. He is an energetic commercial agent. The result is that American firms, quick to respond, have not only sent down travelling representatives, but have opened permanent agencies here, by means of which a great deal of business has been turned away from Canada and Britain. On the other hand, there is no representative of the Canadian Government in this important centre of trade, and I am informed by hotel men that comparatively few Canadian commercial travellers come this way. When they do they frequently find that business has been already grabbed by their American competitors."

The same correspondent interviewed Hon. E. M. Jackman, the Colonial Minister of Customs, who frankly expressed himself against confederation with Canada. "We would lose our political autonomy," he said, "and would become the fag-end of the Dominion." He went on to say that the colony was endowed with great natural resources, such as timber, pulpwood, iron, copper pyrites, slate and other minerals, and these were now being developed by the railway. In addition to these resources and its fisheries, the colony practically controlled the bait supply of the North Atlantic. In estimating the value of the last named asset, he said: "Some of your people may think we place too much value on the control of the last named asset, he said; Some of your people the French the privilege of purchasing bait from our fishermen, and they, receiving large bounties, were driving us out of the Mediterranean markets and ruining our people. We passed an act known as the Bait Act, the object of which was to prevent the French from either catching or purchasing bait in our own waters on the northeast or southwest coast. By a strict enforcement of the Bait Act we have crippled the French. In 1886, the first year we enforced the Act, their catch was 909,953 quintals, but it has been decreasing steadily ever since, and last year it only amounted to 418,307 quintals. This is the direct result of our refusal to give bait to the French. If we transfer to Ottawa the power to deal with these bait fishes and our general fishery laws, it may suit Canadian statesmen to use this leverage in their commercial treaties with France or the United States. It may be argued that Canadian statesmen would be jealous to safeguard the interests of this colony in this matter, but we feel that our interests in this respect are safer in our own hands than in the hands of the farmers of Ontario or our French-Canadian friends in Quebec. We can to-day control our own destiny, make our own treaties (subject, of course, to Imperial ratification) and are, as Kipling says, daughter in our mother's house, but mistress in our own. If we join the Dominion we lose our status as a self-governing colony and become, to use a localism, 'the back linney,' or lean-to, of Canada. The best policy for this colony is to remain independent and be in a position to have two great producing countries competing for our trade and placing their goods on this market cheaper than they will sell to their own people."

These reasons, it will be observed, are partly commercial, partly political, and partly sentimental. They are reasons which naturally influence a public man at a time of material prosperity, such as Newfoundland is now enjoying. But they are not of permanent force. A new generation of public men in place in a time of adversity, or face to face with problems that far outweigh questions of yearly revenue, or which, indeed, may have no connection with commerce at all, may view this subject in a wholly different light. Meantime, the commercial aspect of the case appears to be largely influencing public opinion in the colony, and we cannot blame the islanders for taking a restricted view of federation, when Canadian public men with wider experience have taken such a narrow view of this country's relations with Newfoundland in the past.

Many Newfoundlanders realize that the industrial birth of the colony dates from the advent about six years ago of a firm of Canadians, the Reid Bros., of Montreal, who built the colony's railway and gave a chance for its mines and factories. Previous to that time, the one great industry was the fisheries. What one Canadian firm has so well started can be expanded by other Canadian firms, and our capitalists who have hitherto been putting money into enterprises in South America, Cuba, Mexico, and the West Indies, might well turn their attention to this island where investments would be safe from political disturbances, and where the people are of our own race and of an industrious hardy character.

Meantime has the Canadian Government no offer of preference or of reciprocity to make towards Newfoundland, while the question of the colony's fishery negotiations with the United States are still unsettled?

Sir Robert Bond, the Premier, while opposed to confederation with Canada, pointed out in an interview in London the other day that the United States while getting special privileges in Newfoundland in the fisheries regulations, is taxing, almost to a prohibitive degree, Newfoundland products that go to the United States, and said that Newfoundland could not let this question stand open forever. He hinted at a preferential tariff with Canada. Such a tariff would ultimately be of great advantage to both countries, and the Canadian Government should send a commission of four or five broad-gauge men to St. John's, to negotiate a commercial treaty or preferential tariff in such a spirit as will make amends for the follies of the past.

※ ※ ※

THERMIT.

By producing in a suitable manner the chemical combination of oxygen and aluminum, a temperature is created which is almost equal to that of the electric arc. Fifty

Repair of a Large Engine Wheel with Thermit.

years ago attempts were made to apply the reducing properties of aluminum, but it was not until within the last few years that the reaction has been brought within the sphere of practical operations, when Dr. Hans Goldschmidt, of Essen-Ruhr, Germany, after many years of experimenting, solved the problem

Iron oxide is mixed with finely granulated or pulverized aluminum and the resulting mixture is the heat producer to which the trade mark name "Thermit" is applied. The thermit is poured into a sheet metal crucible lined with magnesite tar; a pinch of ignition powder is placed on top and is ignited with a match. The chemical reaction is started at once and combustion is continued throughout the whole mass, and a temperature of 5,400 degrees Fahrenheit is produced without any external supply of heat. The reaction is complete in thirty seconds, whatever the size of the crucible, and the result is a pure liquid steel which sinks to the bottom and is covered by a perfectly distinct layer of aluminum slag. The steel and slag are run out

Railwelding by means of Thermit.

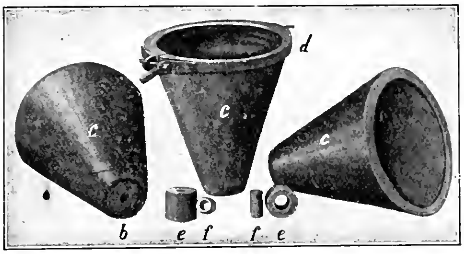
by tapping the crucible from the bottom, and, by regulating the quantity of thermit according to the size of the mould used, the mould may be filled with steel and the slag allowed to flow off.

This is the operation in steel casting or welding by the use of thermit. For the engineer this is the great use of thermit. It is only about a year and a half since this process has been introduced on a large commercial scale, and so far the most important use to which it has been put, is that of welding rails in trolley road construction. The great advantage of the process is the absence of any bulky equipment; all that is required is a crucible, a mould-box, and in some instances, where a complete buttweld of the head of the rail is desired, a rail-clamp. All of these materials, including the necessary quantity of thermit, can be easily moved on a hand-truck. Moulds are made of an ordinary mixture of sand and loam rammed into a sheet metal case and baked. Formerly the rails were superheated before applying thermit, but this is found to be quite un-

necessary, and, in fact, dangerous, as tending to produce explosions.

The same process holds good for the repair of castings, the thermit steel burning itself into the old piece so as to form one solid mass. This is one of the great fields of usefulness for thermit, as in the case of breakdowns of all kinds its use permits the bringing of the repair outfit to the break, instead of necessitating the removal of the break to the shop.

The metal to be cast may be varied by changing the thermit mixture; manganese, carbon, silicon, phosphorus nickel, etc., may be used as ingredients according to the quality of metal desired. In practice, steel turnings are added to the thermit powder, as it is found that by this means the temperature is somewhat reduced, and the formation of gases and the consequent blow holes in the metal, is avoided.



Thermit Crucibles lined with Magnesia. b Flow-hole. c Sheet-iron shell. d Protecting ring. e Large magnesia stone. f Small magnesia stone (thimble).

Besides its uses in welding, casting, repairing, etc., thermit has uses of more especial interest to the metallurgist. By the use of the alumino-genetic reaction, pure metals may be produced, such as: chromium, used in the manufacture of steel; manganese, used in copper and nickel manufacture, and in some sorts of manganese steel; molybdenum, and ferro-vanadium. A number of metals or alloys are also produced, such as ferro-boron, manganese-boron, and lead-boron. Another use for thermit, is a method by which piping is avoided in casting large steel ingots.

Tests are now in progress at the Toronto Railway Company's power house, to demonstrate the feasibility of thermit for welding and repairing. These tests are under the supervision of R. E. H. Buchner, the Toronto representative, Wm. Abbott, of Montreal, the agent for Canada, and Mr. Cole, an expert from New York.

BUSINESS OF THE LATE JAMES COOPER.

It is announced that the railway contractors' and miners' plant business carried on by the late James Cooper, Montreal, has been taken in hand by a new company under the style of F. H. Hopkins & Company, with offices in the new Imperial Bank Building, St. James street. With the co-operation of the executors of the estate, the new firm has been able to retain all the agencies of the old firm, which keeps it in the front rank in this line. The new firm comprises F. H. Hopkins, J. J. Rosevear and R. A. C. McNally. Mr Hopkins was associated with the late James Cooper, and previously with the old firm of Cooper, Fairman and Company for upwards of twenty-three years; Mr. McNally was manager of the Mining Machinery Department, at Rossland, B.C., and later at Halifax, N.S., and Mr. Rosevear was in charge of the finances of the late firm Therefore, all the associates are familiar with the business. Among the agencies taken over by the new firm are the following: Cammell, Laird & Co., Limited, Sheffield, England, steel rails, railway tires, axles, etc.; John Hy. Andrew & Co., Limited, Sheffield, England, saw steel, tool and drill steel; Glasgow Iron & Steel Co., Wishaw, Scotland, structural steel, steel plates, etc.; A. C. Wells & Co., London, England, celebrated Wells lamps; Marion Steam Shovel Company, Marion, Ohio, steam shovels, dredges, unloaders, etc.; Kilbourne & Jacobs Manufacturing Company, Columbus, Ohio, wheel and drag scrapers, wheelbarrows, trucks, cars, carts, etc.; Pittsburg Meter Company, East Pittsburg, Pa., water meters; Ransome Concrete Machinery Company, New York, N.Y., concrete mixers, etc.; Rodger Ballast Car Company, Chicago, Ill., ballast cars, etc.; Duff Manufacturing Company, Allegheny, Pa, track jacks—all kinds; Alexander Car Replacer Manufacturing Company, Scranton, Pa., car replacers; Roberts Car and Wheel Company, Three Rivers, Mich., velocipedes, etc.; Canton Pump Company, Canton, Ohio, steam pumps, etc.; Dominion Wire Rope Company, Limited, Montreal, wire ropes, fittings, etc.

LIGHT, HEAT, POWER, ETC.

Renfrew is now lighted by the Power Company, instead of by the Renfrew Electric Company.

The Ottawa and Hull Power Company is installing a new generator in its power house at the Chaudiere.

An electric light system is being installed for Harbor Grace, Carbonear, and Heart's Content, Newfoundland, using water power. W. A. Mackay is the contractor in charge.

A general meeting of the shareholders of the Winnipeg Electric Street Railway Company will be held on August 2nd to consider the purchase of the capital stock of the Winnipeg General Power Company.

The Toronto & Niagara Power Co. has given a contract to the Dominion Wire Manufacturing Co., of Montreal, for 1,500,000 pounds of copper cable for the power transmission line. The contract is worth about $250,000.

The Manitoba Water Power Electric Company has been incorporated with a capital of $5,000,000 to develop power at Silver Falls, on Winnipeg river, which is claimed to be the greatest electrical power in Canada outside of Niagara.

It is expected that so soon as the Kingston lighting plants are municipalized, the citizens who voted $182,000 to buy the works will be asked to vote another $100,000 to $120,000 to thoroughly equip them, and fit them so as to meet all requirements and to cope with the increasing business for the next ten years.

The St. John (N.B.) Railway Co. has completed an addition to their power plant consisting of a 1,500 h.p. horizontal cross compound automatic condensing Corliss engine, and a 650 k.w. direct connected generator. It is stated that the machinery for the St. John Railway Co.'s lighting system has been entirely renewed.

Frederick Nicholls, of the Canadian General Electric Company, and of the Toronto & Niagara Power Company, E. R. Wood, and D. E. Thompson, K.C., have secured the controlling interests in the Niagara Falls Gas & Electric Light Company. This company has been reorganized, with Mr. Nicholls as vice-president and treasurer. It is their intention to exploit the franchises which the company owns in Niagara Falls, N.Y., and other municipalities along the east side of the river to Buffalo.

The Niagara County Irrigation and Water Supply Company propose to build a power canal from LaSalle, N.Y., where it takes in the water of Niagara river, to the Devil's Hole below the Falls, where there is a sheer drop of three hundred feet. The power house will be located at Devil's Hole. It is stated that the financial end of the enterprise has been arranged through New York parties whose names have not been divulged. The company is operating under a charter procured in 1891. The plant will produce 150,000 horse power, and will cost $10,000,000.

The De Beers Mines Company, Ltd., Kimberly, South Africa, have ordered a third Westinghouse-Parsons steam turbine generating outfit of 1,500 kw. capacity for their power plant at Kimberly. The new turbine unit will be similar in every respect to the two which have been in operation for somewhat over a year. It will operate at 150 pounds boiler pressure, 55 degrees superheat, and about 23 in. vacuum. Taking into account the altitude of Kimberly, this would be equivalent to about 27 in. vacuum at sea level.

NEW CATALOGUES.

The following catalogues may be obtained by those interested by referring to the Canadian Engineer:

The Wm. Hamilton Manufacturing Co., Peterborough: "The McNaull Water Tube Boiler," a fifty-page descriptive booklet, with numerous illustrations.

Keller Heater Co. of Canada, Ltd., Montreal: "Economy in Feed Water and Fuel," a neat booklet, descriptive of the Keller Feed Water Heater and Purifier.

Darling Bros., "Reliance Works," Montreal: Section VII. of General Catalogue, describing the Webster System of steam circulation for heating purposes at or below the pressure of the atmosphere.

The Fairbanks Co., Montreal: Leaflet giving description and price list of Fairbanks' Semibronze Packing.

Canadian General Electric Co., Toronto: Bulletin 831, "Meridian Lamps"; also, Bulletin 834, "Curtis' Steam Turbine."

Geo. B. Meadows, Toronto Wire, Iron and Brass Works Co., Ltd.: Catalogue No. 4, descriptive of bank and office fittings.

J. E. Shantz & Co., Berlin, Ont.: "The Howard Hot Water Heater," an illustrated booklet.

Niles-Bement-Pond Co., New York: "The Progress Reporter," July, 1904; Louisiana Purchase Exposition special number.

Westinghouse Industries: A booklet descriptive of the twenty-three Westinghouse companies exhibiting at the St. Louis Fair.

Mason Regulator Co., Boston: Price List Mason Reducing Valve Parts, issued July 15th.

Morse Twist Drill Co., New Bedford, Mass.: 1904 Catalogue. A 250-page catalogue of drills, reamers, milling tools, etc., together with appendix containing tables, instructions, etc.

Link Belt Engineering Co., Philadelphia: "The Renold Silent Chain Gear, 1904 edition," a neat booklet descriptive of the Renold silent chain for power transmission. Also, "Retail Coal Pockets," a booklet giving detailed information as to equipment, plan, etc.

Berger Manufacturing Co., Canton, Ohio: "Steel vs. Wood," a booklet describing steel office furniture and appliances.

Diamond Saw and Stamping Works, Buffalo, N.Y.: Booklet and price list of Sterling hack saws.

St. Louis Expanded Metal Fireproofing Co., St. Louis, Mo.: "Corrugated Steel Bars as Applied to Steel-Concrete Construction," a 125-page booklet, profusely illustrated with photographs and diagrams, and also containing many tables and formulæ for concrete construction.

Abner Doble Co., San Francisco, Cal.: "Tangential Water Wheels," descriptive of Doble ellipsoidal-bucket water-wheels.

Arthur Koppel, New York: Supplement to Catalogue No. 77, showing illustrations of narrow gauge locomotives.

Westinghouse Machine Co., East Pittsburg: "Steam Turbine Test," being brake tests of a 400 k.w. Westinghouse-Parsons steam turbine.

Jeffrey Manufacturing Co., Columbus, Ohio: "Electric Locomotives for Gathering Purposes," Bulletin No. 8; also, "Jeffrey Water Elevators," a price list.

Chicago Pneumatic Tool Co.: Catalogue of Air Compressors built at Franklin, Pa., containing information as to erection, care and adjustment of compressors and tables of value to those interested in pneumatics.

The city council of Montreal has voted $10,000, towards the preliminary expenses of a permanent exhibition.

TELEPHONE AND TELEGRAPH.

J. E. MacMahon, who invented the tape ticker, died recently at Newmarket, Eng.

Tenders for a telephone franchise in Toronto will be received on or before October 1st.

Manchester, Eng., is about to establish a great inter-municipal telephone plant in co-operation with a dozen neighboring towns.

Arnprior has followed the example of Carleton Place in disposing of the Bell Telephone Co.'s appeal by adding another $1,000 to their assessment.

The British Government will bring in a bill making wireless telegraphy throughout the United Kingdom a Government monopoly. The post-office officials have been experimenting with a new system of their own.

The Bell Telephone Co. has won its case against Owen Sound. The company began putting a conduit across Poulette Street, but the town interfered. An injunction to restrain the town from interfering was asked for, and is granted. Justice Meredith characterized Owen Sound's claims as extravagant.

Two of the six Marconi wireless telegraph stations being constructed on the St. Lawrence for the Dominion Government are now in operation—one at Fame Point and one at Heath Point, Anticosti. The Parisian was reported on July 15th by the Heath Point station, being the first vessel to hold communication with the station.

MISS RAE PETRIE.

Miss Petrie, whose likeness appears above, is a daughter of H. W. Petrie, head of the machinery firm in Toronto bearing his name. On July 20th Miss Petrie distinguished herself by a daring rescue off Toronto Island. A party of three, two ladies and a gentleman, were seen about a mile off the shore clinging to an upturned canoe. Finding that none of the men near by would venture out, Miss Petrie seized a canoe which was handy and went to the rescue, accompanied by a young boy whom she induced to go along. Miss Cosgrave, a sister of one of the party in danger, went out in a canoe a little later, and by lashing the two canoes together they managed to get all three safely on board, and brought them to shore. The party rescued were Miss D. Cosgrave, Miss I. Kidner, and Mr. Arthur Murdoch. Miss Kidner had sunk once before Miss Petrie's approach. Miss Petrie has been recommended for a Humane Society medal. She is the recipient of many letters of congratulation from relatives of those rescued and others. This is the first time The Canadian Engineer has published in its columns an individual portrait of a lady, but, like others, it wishes, in some slight measure to recognize Miss Petrie's heroism.

PERSONAL.

Louis Terven, E.E. (University of Wisconsin) has been appointed chief electrician of the Nernst Lamp Company, Pittsburg, Pa. Mr. Terven was for some time electrician of the United States Navy Yard, Port Royal, S.C.

Mr. T. C. Streeter, who has been connected with the B. and M. Railway for the past twenty-five years, has resigned his position with that road to enter the service of the Quebec Central R.R. as a member of the head office staff.

It is reported that F. B. Wade, M.P., is to be chairman of the commission to build the eastern section of the Grand Trunk Pacific Railway. Mr. Wade was born at Granville, N.S., in 1852, and educated at Belle Isle. He was elected to the House of Commons for Annapolis in 1900.

A. L. Waterbury, who was at one time first vice-president and general manager of the Citizens' Telephone Co., of Houston, Tex., has accepted a position as general manager of the sales department of the American Conduit Co. Mr. Waterbury will have his headquarters at the Chicago office of this company, 1005-6 Manhattan Building.

John J. Long, president of the Collingwood Shipbuilding Co., was mysteriously drowned in the Don at Toronto early in July. He was a very hard worker, and was not in good health. Besides being president of the shipbuilding company he was a member of Long Bros., Collingwood, vice-president of the Collingwood Meat Co., vice-president of the Anglo-American Fire Insurance Co., director of the Bank of Toronto, director of the Northern Navigation Co., and was connected with various other companies. He was born in Limerick, Ireland, in 1843.

It is stated that Sir Percy Girouard, late Commissioner of Railways in the Transvaal and Orange River Colony, may be asked by the Dominion Government to take charge of the Moncton-Winnipeg section of the Grand Trunk Pacific. Sir Percy was born in Montreal, and received his education at the Royal Military College. His work in connection with the construction of the Egyptian and Soudan railways, between 1896 and 1899, won for him international prestige as a railway builder, and his subsequent services in connection with railway construction and reorganization in South Africa have enhanced the high reputation previously won.

Alexander Gartshore, the well-known founder, of Hamilton, died on July 13th, in his sixty-fifth year. He was a son of John Gartshore, of Lanarkshire, Scotland, who was one of the pioneer iron founders in Canada, and established a foundry in Dundas in the early days. In 1858 Mr. Gartshore entered his father's works in Dundas, and was admitted to a partnership in 1865. In 1870 the business changed hands, and Alexander Gartshore moved to Hamilton, where he formed a partnership in the manufacture of railway castings, etc., the firm name being Gartshore & Cowie. Mr. Gartshore eventually bought out Mr. Cowie's interest in the business, but a few years ago he took Mr. Thompson in as a partner, the firm becoming the Gartshore-Thompson Pipe and Foundry Co., Ltd. He was the first man to embark in the iron pipe industry in Canada, and he made a great success of his business. He it was who drew the plans for the first pumping engine for the Hamilton waterworks system. That was in 1857. The deceased was active in military matters in his earlier years. He was a member of Notman's Foot Artillery in Dundas in 1858. When the present King of England visited Canada as the Prince of Wales Mr. Gartshore was an officer in the sedentary militia. He was a master Free Mason, a member of St. Andrew's Society and a member of Central Presbyterian Church. In politics he was a Conservative. He is survived by a widow, two daughters, Misses Mary and Jessie, and three sons, Alexander L., of Vancouver, and John William M., of Hamilton.

On Thursday, July 21st, the Montreal branch of the Canadian Manufacturers' Association tendered a banquet to George E. Drummond, the president of the Canadian Manufacturers' Association, and also president of Montreal Board of Trade. The key-note of the speeches of the occasion was Imperialism and the upbuilding of Canada. Mr. Drummond, in reply to the toast, "Our Guest," told of his recent visit to Great Britain, when he met many men prominent in trade and politics in the old land, including Mr. Chamberlain. He described Mr. Chamberlain's characteristics as he had found them, and made a vigorous speech in favor of a reorganization of the Empire along preferential trade lines. Speaking of Canada as the pivotal point in any such scheme, he said he was convinced that the time had arrived when "our Parliament should voice the wish of the Canadian people as expressed by our trade organizations; that the general interests demand that our Parliament should move to get a mutual preferential trade arrangement that will make for the permanent consolidation of the Empire." In an interesting and eloquent manner he argued this position from a trade standpoint, from a Canadian national standpoint, and from an Imperial standpoint. "The Canadian people must unite on a policy for self-preservation and for permanent unity with the Empire. The Halifax platform of the Manufacturers' Association is built upon common sense principles, and the policy outlined therein is born of practical experience in a practical age. Canadians can unite on this platform for the safety, prosperity, and progress of Canada and the Empire." Speeches were made also by Robert Meighen, Hon. Raymond Prefontaine, Hon. L. P. Brodeur, R. L. Borden, M.P., and F. D. Monk, M.P.

Editor Canadian Engineer:

Sir:—In your issue of June last I noticed a "Personal" item respecting T. H. Wiggins, of this department, and think it should be corrected, as this gentleman's name is frequently appearing in print laying claim to undeserved honors, and positions of responsibility. Mr. Wiggins has never been connected in any way with Irrigation work, which is administered here under the direction of the Department of the Interior at Ottawa. B. J. Saunders was Deputy Commissioner of Public Works and Chief Engineer of Irrigation until March 31st last, when he resigned, and was succeeded by John Stocks, then Assistant Chief Engineer of this Department. You will find in the Canadian Society of Civil Engineers list of Associate Members for 1904, that Mr. Wiggins has supplied himself with the position of Assistant Chief Engineer of the North-West Government, a position which he has never held or been offered; I succeeded Mr. Stocks in this position on April 1st of the present year. Mr. Wiggins was formerly Assistant Chief Surveyor of the Department of Public Works, and is now Drainage Engineer and District Engineer & Surveyor. It seems to me that it is time to put a stop to this cheap advertising of imaginary honors to which there is no title, and is never likely to be.

Will you kindly give the same publicity to these facts as was given the original item.

R. W. Macintyre, Assistant Chief Engineer, Department of Public Works, N.W.T.

Regina, July 19th, 1904.

* * *

This year up to June 30th the Yukon has produced $3,866,317.85 worth of gold, an increase over the same period last year of $147,352.75.

A fifty-ton Elmore oil concentrator is being built by the Massey Station Mining Company. The Massey is a copper mine with ore one to seven per cent. About $500,000 worth is said to be on the dump.

Johnson and Fry, gold miners and prospectors, have discovered a rich deposit of scheelite in the Willow Creek region of Cariboo. Hitherto the only place in the world that scheelite has been found is Northern Australia. Johnson and Fry say they have an immense deposit, which they will work at once. Scheelite is the mineral from which tungstic acid is manufactured.

W. E. H. Carter, secretary of the Provincial Bureau of Mines, has returned from a tour of inspection of the mines of New Ontario in the neighborhood of Sault Ste. Marie and Sudbury. At Sudbury the Canadian Copper Company have just completed a new smelter with a capacity of 1,000 tons per day, and it will be put in operation at once. The company's main mine is now yielding ore at the rate of 900 tons per day.

A. C. vs. D. C. ARC SYSTEMS.

A Paper read by W. L. McFarlane before the Canadian Electrical Association.

For reasons apart from arc lighting, the tendency at present in equipping electric power stations is towards the installation of A. C. generators of large capacity. The source of power may be water or steam, or a combination of both. Having regard to this established tendency we will consider the bearing of the arc system on it and the relative costs and advantages of the different systems.

Arrangements Available from the Different Sources of Power.

If water power is used, and the frequency of the system is between 40 and 125 cycles, the arc lighting will probably be done either by arc dynamos driven by A. C. motors of the synchronous or induction type, or by transformers operating A. C. arc lamps. If the frequency in use is lower than 40 cycles, the transformer and A. C. arc lamp arrangement will only be practical through the medium of frequency changers. Should engines be the prime movers, A. C. transformers and arc lamps may be used, or arc dynamos may be driven direct from an engine or by motors.

When, as is often the case, a combination of engines and water power has to be used, A. C. transformers and lamps, or motor driven arc dynamos are possible as in the other two cases, there being also the arrangement where the arc dynamos are operated from line shafting to which are connected both an A. C. motor and an engine. By means of suitable clutches or quills, either the motor or the engine can be used to supply the necessary power to the shafting. When mentioning here the A. C. transformers and arc lamps, the series alternating enclosed arc lamp system operating from constant current transformers is meant. Multiple constant potential arc lamps, of both the open and enclosed type, are extensively used for inside lighting, and occasionally for outside street lighting, but only when there is some special reason for so doing. In the case of the D. C. arc system, we have to consider the open and enclosed lamp, and the small arc dynamo and its larger and more modern rival. Generally speaking, there are four systems of series arc lighting at present in use, namely:

1st. The small arc dynamo supplying about 50 open lamps at 9.6 or 6.6 amperes.

2nd. The larger and more modern arc dynamo supplying as many as 175 open lamps in series, or, by the multi-circuit arrangement.

3rd. Large arc dynamos wound for 6.6 amperes for supplying current to enclosed lamps.

4th. Transformers to which are connected circuits having as many as 100 constant current series alternating enclosed arc lamps.

Whichever one of these systems of arc lighting is in use in a station, in all probability only a small portion of the total energy generated is delivered to the arc system, the larger portion being taken care of by comparatively large A. C. generators arranged with the object of keeping operating, maintenance, and all other costs at a minimum. Under these circumstances we will consider the four different systems of arc lighting mentioned, assuming, for the sake of simplicity, an arc equipment of 500-480 watt lamps, in a station of 3,000 K. W. capacity. For the same reason, and owing to the great difference of opinion on the subject, the induction motor will be considered instead of the synchronous motor; the former, while having a poorer power factor, will be less affected by trouble on the system, besides requiring a much simpler means of control and less experienced attendants than the synchronous motor.

Small Dynamos of About Fifty Lights Capacity.

For this class of service, about eleven arc dynamos, with the necessary shafting and belting, and an engine or motors to drive them will be required, and owing to the space occupied, a special department, or perhaps a special station, will require to be devoted to it, thus incurring special ex-

TABLE No. 1.

Showing Comparative Approximate Annual Station Costs, Using Small Arc Dynamos.

Items of Cost		Water Power		Steam Power		Water Power with Steam Reserve			
		60 Cycles	25 Cycles	60 Cycles		60 Cycles		25 Cycles	
Account	Sub-Account	Motors and Shafting	Motors and Shafting	Motors and Shafting	Engine and Shafting	Engine and Motors Driving Shafting	Motors and Shafting	Engines and Motors Driving Shafting	Motors Driving Shafting, Reserve Steam Power Through Frequency Changers
		$	$	$	$	$	$	$	$
Construction..	Engine	....	....	....	10000	10000	....	10000	....
	Motors / Motor S.B. and Conn.	11000	11000	11000	....	11000	11000	11000	11000
	Shafting and Belting	2888	2888	2888	3101	4328	2888	4328	2888
	Arc Dynamos / Arc S.B. and Conn.	11000	11000	11000	11000	11000	11000	11000	11000
	Foundations	880	880	880	1720	1880	880	1880	880
	Total	25768	25768	25768	25881	38208	25768	38208	25768
Maintenance..	Interest and Depreciation	3865	3865	3865	3882	5731	3865	5731	3865
	Engine	....	....	....	200	50	....	50	....
	Motors / Motor S.B. and Conn.	120	120	120	....	120	120	120	120
	Shafting and Belting	202	202	202	221	303	202	303	202
	Arc Dynamos / Arc S.B. and Conn.	650	650	650	650	650	650	650	650
	Total	972	972	972	1071	1123	972	1123	972
Operating.....	Wages	1768	1768	1768	2253	1768	1768	1768	1768
	Supplies	462	462	462	612	462	462	462	462
	Total	2230	2230	2230	2865	2230	2230	2230	2230
Grand Total		7067	7067	7067	7818	9084	7067	9084	7067

penses, which can only be determined for individual cases. However, three men at least will be required for operating, and as the efficiency of this system will be about 54 per cent., the power required will be approximately 600 h.p. The conditions of operating necessary for an arc plant of this kind are too well known to require their being mentioned in detail here.

Table No. 1 is intended to show the comparative annual station costs when small arc dynamos are operated under the different conditions of motive power, namely: Water power with 60 or 25 cycle motors; steam power using an engine direct, or motors obtaining current from large A. C. units; and water power with steam reserve employing a combination of engines and motors. In the extreme right-hand column of this table the heading is "25 cycle motors driving shafting, the reserve steam power being obtained through frequency changers." No portion of the cost of these frequency changers has been charged to the arc installation, as doubtless frequency changers will have been installed for the incandescent service, and in the event of the 60 cycle steam reserve being required, these frequency changers will be available for use in connection with the motors driving the arc apparatus, changing the 60 cycle steam power to 25 cycles for the motors.

Large Dynamos of About 125 Lights Capacity.

We will here consider large arc dynamos of both the 9.6 and 6.6 ampere type, as they rank about the same as regards their convenience in the station, and should it be desired to change the current of the former, they can be rewound for approximately 25 per cent. of their original cost. Owing to their compactness and cleanliness, it may not be necessary to isolate these arc machines, whether engine or motor driven. About five dynamos will be required, which, if motor driven, can be connected direct, two to each motor, while, if engine, or engine and motor driven, it will probably be necessary to employ shafting, which, while occupying considerably more space, can likely be accommodated in the main station. If this arrangement is adopted, it is likely that the engineer on duty will be sufficient to attend to the engine, which might be driving the arc dynamos, and under most conditions it will not be necessary to employ additional dynamo attendants, although the men called upon to attend the arc dynamos will have to be more intelligent than would otherwise be necessary, and owing to the increased work an extra cleaner will have to be provided. Most modern plants operating twenty-four hours per day work their operators on eight-hour shifts, having them change shifts fortnightly, and as arc dynamos often have individual and variable peculiarities in their operation, this continual changing of operators often results in more or less deterioration in the service; this is reduced to a minimum, however, by employing a high class of operators. For the keeping of these dynamos in first-class condition, about half the time of a first-class attendant is required during the daytime; this work should always be done by the same man.

The type of arc dynamo which allows of the use of either the straight series or the multi-circuit arrangement of circuits is a decided advantage in allowing of the use of large dynamos without the necessity of increasing the P. M. F., and, to a great extent, the insulation of the circuits. It has been found, however, that the circuits have to be kept in much better repair when the multi-circuit arrangement is in use than is necessary when using small dynamos, because if any grounds or leakage occur between any of the circuits operated by means of the first-mentioned arrangement, it has a tendency to short-circuit sections of the armature, and act on the commutator, causing flashing to an extent which very materially affects the operation, making it necessary at times to separate the circuits.

Intermittent trouble of this nature is particularly annoying, and the linemen find it very hard to locate. In one place, where considerable trouble of this nature was experienced, the cause was found to be due, to a great extent, to the use of film cut-outs, having wooden mountings, enclosed in iron cases. In the place referred to the conditions are such that it is very hard to maintain the circuits in perfect condition, and, while the best of attendants are provided, and these dynamos have been in service for more than two

TABLE No. 2.
Showing Comparative Approximate Annual Station Costs, Using Large Arc Dynamos.

Items of Cost		Water Power		Steam Power		Water Power with Steam Reserve			
		60 Cycles	25 Cycles	60 Cycles		60 Cycles		25 Cycles	
Accounts	Sub-Accounts	Direct Connected Sets	Direct Connected Sets	Direct Connected Sets	Engine and Shafting	Direct Connected Sets, Power A.C., G. Water or Steam	Engine and Motors Driving Shafting.	Engine and Motors Driving Shafting	Direct Connected Sets, Reserve Steam Power Through Frequency Changers
		$	$	$	$	$	$	$	$
Construction..	Engine	....	....	....	10000	....	10000	10000	....
	Motors Motor S.B. and Conn.	13500	13500	13500	....	13500	11000	11000	13500
	Shafting and Belting	....	....	....	2618	....	3893	3893	....
	Arc Dynamos Arc S.B. and Conn.	19200	19200	19200	19200	19200	19200	19200	19200
	Foundations	400	400	400	1400	400	1510	1510	400
	Total	33100	33100	33100	33218	33100	45603	45603	33100
Maintenance..	Interest and Depreciation	4965	4965	4965	4982	4965	6840	6840	4965
	Engine	....	....	....	200	....	50	50	....
	Motors Motor S.B. and Conn.	180	180	180	....	180	180	180	180
	Shafting and Belting	....	....	....	183	....	282	282	....
	Arc Dynamos Arc S.B. and Conn.	300	300	300	300	300	300	300	300
	Total	480	480	480	683	480	812	812	480
Operating.....	Wages	832	832	832	1317	832	832	832	832
	Supplies	176	176	176	276	176	176	176	176
	Total	1008	1008	1008	1593	1008	1008	1008	1008
Grand Total		6453	6453	6453	7258	6453	8660	8660	6453

years, to this day there is not as good service obtained from them as was obtained from the smaller machines. This is not intended as a reflection on large arc dynamos, as, of course, the remedy for the trouble above mentioned is to look after the circuits; but very often this is not appreciated, especially if the line trouble men have been educated on the old system.

The power required where large arc dynamos are used varies from 397 to 427 h.p., and the efficiency is from 75 per cent. to 81 per cent., depending on whether direct connected sets, motors and shafting, or engines and shafting are in use.

Table No. 2 gives the approximate annual station costs when large arc dynamos are used under the different conditions mentioned. A comparison of tables numbers one and two shows a saving of only about one dollar per lamp in favor of the large dynamos, but, we must remember the saving in floor space, and that we have not yet taken into account the lamps themselves; also, that there is a saving in power of about 175 h.p.

Series A. C. Arc Lamp Transformers.

It is not absolutely necessary to use transformers for the operation of series A. C. lamps, as circuits of 25 and 50 lamps after passing through regulators could be connected direct to the station busbars, the E. M. F. of which would require to be 2,000 and 4,000 volts respectively, and, while this arrangement would give an increased power factor, and might give fairly good results, when used in small plants having but one or two circuits, it should not be used in a plant of 500 arc lamps such as we are considering, for the reason that any defects in the arc circuits would affect the remainder of the system.

When using transformers, whether these should be arranged to supply circuits of 25, 50, 75 or 100 or more arc lamps would depend on conditions which usually have to be considered before determining the E. M. F. most suitable for use on any circuit. The higher the E. M. F., the better must be the insulation of the equipment generally, and, in the event of a break down, a larger number of lamps are affected. As the insulation and general lay-out of the arc equipment of most of the existing plants has been arranged for circuits of about 50 lamps, and as this represents in the case of enclosed lamps an E. M. F. of 4,000 volts, an amount which, with the exception of a few minor details, is within the safety limits of the existing construction, it would seem that in adopting the A. C. system, circuits of about 50 lamps or 4,000 volts should be recommended. If circuits of 50 lamps are used, the space necessary for the installation of the transformers will be about 325 square feet. With the object of reducing the length of the circuits, some of these transformers might be located in possibly existing sub-stations, but this would result in increasing the operating expenses, and the cost of switchboards, therefore the locating of the complete arc system in the main station, would most likely be advisable. The switch-board, preferably of the universal type, should be fitted with an ammeter, fuses, incandescent pilot lamp, and switch for each circuit, and if, as is likely the case, the main system is polyphase, the circuit switches should be suitable for connecting the circuits which they control to any of the different phases, this having been found a very convenient means of balancing the load on the system. A testing panel should also be part of this switchboard, being fitted with a volt, ampere and watt meter for obtaining power factors, etc., and for checking ammeters on the circuits. This panel should have a ground detector, as well as a transformer or other suitable means of obtaining about 300 volts to be used for testing the circuits during the daytime, and for supplying current to assist in the closing of open circuits during night or day. This arrangement reduces the danger to linemen, who work with only 300 volts on the defective circuit, testing from place to place with a lamp, which they use as they formerly did the wire jumper. This arrangement of testing is, of course, not possible where shunt lamps are in use, as in this type the carbons remain apart. For the system of 500 lamps under consideration, eleven 50 lamp transformers should be installed, one of these being used as a spare. If suitable taps are brought out from the winding of the transformers, a variable ratio may be obtained, allowing for the number of lamps on the circuit being a few more or less than 50 without the power factor being changed to any extent.

Constant current transformers having movable primary or secondary coils are much more compact and neater than the constant potential transformers used in conjunction with an inductive regulator, and the former may have the advantage of the multi-circuit arrangement, but this necessitates double the number of circuits being brought back to the station, which is practically the same as making our circuits for 25 lamps. We might, however, use 100 lamp transformers with the multi-circuit arrangement and same floor space, but this also applies in a measure to constant potential transformers. The inductive regulator is a much more substantial piece of apparatus than the movable mechanism in a constant current transformer, and in cases of intermittent circuit trouble, when the regulating mechanism is severely taxed, the separate regulator will give the best satisfaction, and require the least attention. With the A. C. system installed in the main station, no additional attendants will be required, and the operating supplies will hardly be appreciable, while the maintenance as compared with the same capacity of revolving machinery will be very small indeed. Of course, the power for this system is obtained from revolving machines, but it is probable that it is only a portion of the full load capacity of one of a number of units employed. If a frequency of 25 cycles is being used, the operation of the A. C. arc system is made more complicated, owing to frequency changers being necessary, and while these may be employed in any case in connection with all or a portion of the main system, yet they lower the efficiency, and there is always the danger of interruption to the service due to the synchronous machines getting out of step from short-circuits or other causes, which objection does not exist to the same extent when induction motor driven arc dynamos are used.

TABLE No. 3.

Showing Comparative Approximate Annual Station Costs, Using Constant Current Transformers.

Items of Cost		Water Power		Steam Power	Water Power Using Steam Reserve	
Account	Sub-Account	60 Cycles	25 Cycles	60 Cycles	60 Cycles	25 Cycles
		$	$	$	$	$
Construction..	Transformers	6600	6600	6600	6600	6600
	Switchboard	1500	1500	1500	1500	1500
	Total	8100	8100	8100	8100	8100
Maintenance..	Interest and Depreciation.....	1215	1215	1215	1215	1215
	Transformers	....	....	....	....	....
	Switchboards	150	150	150	150	150
Operation.....	Wages	....	....	....	....	....
	Supplies	50	50	50	50	50
Grand Total	....	1415	1415	1415	1415	1415

With A. C. transformers on a 60 cycle system, the power required will be about 347 h.p., the efficiency being 93 per cent. As in the other two systems of arc apparatus considered, a tabulated sheet (No. 3) has been made, showing the comparative annual cost of this system. As it is impossible to say (except in individual cases) what proportion of the cost of frequency changers should be charged to the arc system, when 25 cycles are in use, this item has been omitted in this table, but will be considered in the cost of power later.

(To be concluded in September issue.)

MINING MATTERS.

The Sault Express announces rich gold strikes in the vicinity of Webbwood.

The Edmonton Gas and Oil Company, is engaging drillers and buying apparatus to begin drilling immediately for gas or oil in the vicinity of Edmonton.

The Foley mine at Fort Frances, is to be reopened. Mr Bowden, of Haughton, Mich., the president of the company, is satisfied that the property will pay for operation.

Preston has passed a by-law to raise $27,000 to purchase the incandescent and arc plants now in use. A new power station will be erected and a first-class plant will be installed.

The Vermilion mine, which has been idle for several years, is now operated, yielding gold, nickel, cobalt, silver, platinum and copper. It belongs to the International Company.

Foundations have just been laid for four hundred coke ovens for the International Coal and Coke Company, at Coleman, Alta. The company expects soon to be able to get out 1,000 tons of coal, and make 500 tons of coke daily.

The Canada Refining Company, with headquarters at Ottawa, has leased the Black Donald graphite mines for a period of two years, and has started in to carry on operations on an enlarged scale. Electric power will be utilized.

Diamonds have been discovered in the matrix at Oakley Creek, twenty miles from Inversell, New South Wales. The matrix is of deloric rock, which experts claim to be of similar formation to the South African diamond bed. This is the first discovery of diamonds in Australia.

The Westinghouse Electric Company, of Lancaster, Penn., has installed the electric apparatus in connection with the gold dredge operated on Poorfarm flats, Pine Creek, Atlin, B.C. This method of mining is said to be proving profitable, the dredge having given splendid returns since operations commenced.

The Colonial Copper Company have established extensive works for the concentration of ore at Cape D'Or, in the Minas Channel, N.S. Manager S. G. Painter says the production amounts to 200 tons of ore per day, and that the output will soon be doubled. This copper he declares can be placed in New York at five cents per pound.

Capitalists represented by J. C. Ferneau, have definitely decided to erect a zinc smelter at Fernie, to cost not less than $100,000. The zinc silver-lead ores of the Slocan will be treated. The object in locating at Fernie, is to bring the ore to the fuel, on account of the fuel being the larger tonnage. A zinc enriching plant will be erected at Rosseberry, in the Slocan district by the same people.

It is expected that work on the corundum property owned by the Corundum Refiners, Limited, of Palmer Rapids, Ont., will be commenced shortly. Some delay was caused owing to the inability of the company to secure the water-power at that place, but it is now probable that satisfactory arrangements will be made. This company has secured from the Government and by private purchase, some fourteen hundred acres of rich corundum lands in Raglan township, Renfrew county, this tract representing almost all of the corundum deposit remaining in the Province. The company are erecting a mill, which they expect will be in operation next summer.

Thamesville has decided to purchase the electric light plant.

Star of the East Gold Mine, (near Peterboro,) shows an improvement as the streak descends. Quartz which assayed $180 at the surface now scores $196. E. J. Cowain, the superintendent is now arranging for the installation of a new stamp mill.

Two seams of first-class bituminous coal, one seam eleven feet wide, the other six feet, and in close proximity, have been discovered not far from Ladysmith, B.C. Experts attach great importance to this discovery, owing to the exporting port of Ladysmith. The new coal is declared to be a continuation of the famous Wellington seam, and it can be easily worked owing to the pitch of the veins.

There is a great deal of talk in Kaslo about the discovery of a large ledge of dry ore on the south fork of Kaslo creek, at a distance of 15 miles from the town. Some samples of antimonial silver from the ledge have been brought in which run 2,000 ounces in silver to the ton. The find is causing considerable excitement. It was made by J. P. Miller, a mining man of Kaslo.

Work at the Radnor iron mine in Grattan, Ont., was suspended and will probably remain so for some time. The reason for this move is not clear, but it is generally understood that the owners of the mine, the Messrs. Drummond, of Montreal, are not satisfied with the present condition of the iron industry in Canada, and are endeavoring to induce the Government to increase the duty on ore from the United States.

T. W. Gibson, Director of Mines for Ontario, has received a report from New Caledonia, the French penal island, which is practically the only nickel producing territory in the world besides Ontario, and it shows that the industry is flagging there. While in 1902 the island produced 129,653 tons of nickel ore, it raised only 77,360 tons in 1903, which is only about half of the output of the Copper Cliff, Ont., mines.

The Imperial Coke and Coal Company has acquired control of the Alberta Coal and Coke Company. The conditions demand that the coal lands of the Alberta company be at once developed, and provided with coke ovens and other plant. The Alberta company owns 6,400 acres on the Crow's Nest Railway, near Cowley, Alta. The Imperial Company owns ninety sections of land six miles from Michel, in British Columbia. W. Applequist, D. McLeod, and H. McLeod were the principal owners of the Alberta company.

G. O. Buchanan, inspector of lead bounties, speaking in Nelson, B.C., said: "The production of lead at present is at the rate of 30,000 tons per annum, though I do not know that it will continue at that rate for a year. This heavy production is caused largely by the heavy shipments of the St. Eugene mine, which is producing 1,500 tons of metallic lead per month. This output was never exceeded in this country but once, and that was in 1900, when the output was 31,000 tons, the production that year having been stimulated by the extraordinary prices in London. The country is in a better condition to take care of its lead than it has ever been."

"Cobalt" is to be the name of one of the new towns on the Temiskaming railway. It will, according to the decision of the Town Site Committee, be situated on Long Lake, about fifty-eight miles north of North Bay, and from present indications it will be one of the most important mining towns in Canada. It was in this locality that the rich finds of nickel, cobalt, arsenic, and silver, were made last fall, and cobalt has been given the preference in the naming, because the cobalt ores found are among the richest and finest known to scientists. An army of prospectors are at work in the district, and T. W. Gibson, Director of Mines, states that, although the country is a difficult one to explore, enough new discoveries have been made this spring to demonstrate that the mineral bearing area is larger than was at first supposed.

The deputation sent by the Brantford city council to investigate the municipal telephone system of Port Arthur and Fort William has returned and reported in favor of municipal ownership. It is estimated that Brantford could operate a 500 telephone exchange at $15 for residences and $25 for business places. Applications for municipal phones are now being solicited, and as soon as 500 are received a by-law will be submitted authorizing the issue of debentures to raise the money required to instal the plant.

Webster City, Iowa, is a municipal ownership city, owning its waterworks, electric light and power plant, and heating plant. A year ago the city gave a gas franchise to a private company, but the contract has been proved illegal, and the Practical Gas and Construction Co., of Chicago, is now endeavoring to secure the franchise. Neither of the dailies in the city is strenuous enough in its promulgation of the municipal ownership ideal, so the city council is launching a strictly municipal ownership daily, with a prominent alderman as editor and other members of the council as assistants. With the single exception of the heating plant, all the city's enterprises have proved paying investments. Its latest municipal venture will be watched with interest.

WIND-DRIVEN ELECTRICAL WORKS.

Dr. Alfred Gradenwitz, in Knowledge, London.

Professor Latour, of the Askov Popular Academy (Denmark) has for some years been engaged on behalf of the Danish Government in investigating the problem of utilizing wind power in connection with small electricity works. If, however, the dynamo be direct-coupled to the wind motor, the results obtained are unsatisfactory on account of the exceedingly variable speed of the wind. As pointed out in an address recently delivered by Professor Latour before the Copenhagen Technical and Hygienic Congress, he was met with difficulties in designing a suitable regulator for controlling the speed of the dynamo. At present, however, these difficulties appear to have been overcome, and an electricity central station near Askov has been worked with wind power for a year with satisfactory results.

The arrangement of a similar electricity works is represented diagrammatically in Fig. 1. The regulating device itself is made up of two different parts. The mechanical regulating device is intended for maintaining at constant values the peripheric force transmitted to the belt disc of the dynamo. The two belt discs R R are mounted on a movable arm A, bearing a counterweight P. The resulting tension of the belt is thus kept constant, depending on the weight of the belt discs as well as on the counter-weight P. The ratio of the resulting belt tension and the maximum peripheric force susceptible of being transmitted by the belts is, however, practically constant. The peripheric force transmitted by the wind motor to the belt disc R accordingly cannot exceed a given value, the torque of the dynamo remaining below a corresponding value. Any surplus energy developed by the wind motor is lost as heat with the friction of the belt. A constant torque of the dynamo axle will, however, correspond with a constant current intensity in the armature. In the case of the magnetizing intensity employed, the load is in fact practically proportional to the speed, so that the intensity of the current may be regarded as constant. This is further demonstrated by the author's measurements.

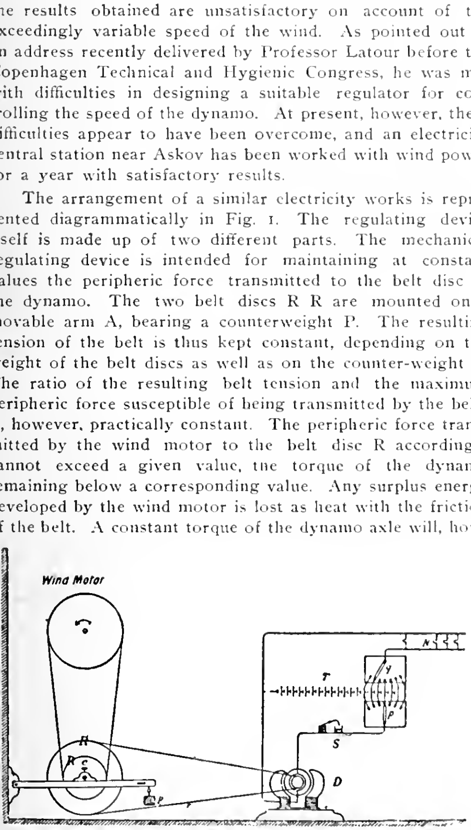


Fig. 1.

The current from the dynamo is used to charge an accumulator battery represented diagrammatically in Fig. 1 The cut-out switch F is closed, provided the current intensity be not inferior to its normal constant value. The dynamo D, therefore, works at a variable speed. In the case of the wind being so strong as to absorb part of the energy by the friction of the belt, the system will work in the following way: Assuming the accumulator battery to be nearly discharged and the crank of the cell controller to be adjusted for the total charge of the battery, the dynamo will run at a speed so high as to be quite sufficient to charge the battery with the normal current of a dynamo (e.g., 50 amps.). As the charge increases, the dynamo will automatically increase its speed and load so as to make the changing current constant. The cell-controller will have to be resorted to in charging in exceptional cases only—if, for instance, the charging and discharge of the battery takes place at the same time.

The electrical regulating device is situated in the interruptor S, being mainly an ordinary minimum current interruptor, disconnecting the dynamo as soon as the current decreases below the normal number of amperes. This arrangement is necessary to prevent the accumulator battery

from being discharged through the dynamo when the strength of the wind is small. The interruptor, however, will automatically insert the current as soon as the wind again assumes a greater strength. To attain this result, the current interruptor is provided with a tension regulator, inserting the current as soon as the speed of the dynamo has sufficiently increased. In the case of variable strengths of the wind, the plant may thus accumulate any amount of wind available, the interruptor opening and closing the connections continually. On the switchboard there are in addition two ammeters and one voltmeter.

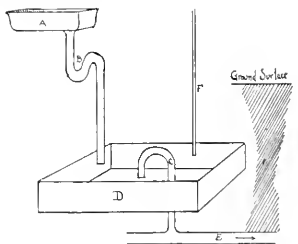
A small electricity works arranged in accordance with the foregoing principle has, as above mentioned, been in operation in Askov since the beginning of last autumn, supplying the inhabitants of the neighboring communities with electric current. The constant normal current supplied by this installation is 60 amps. at tension of 220 volts. As a reserve, however, in cases of several days' calm weather, a petroleum motor had to be installed. The plant has so far given every satisfaction, requiring no superintendence worth speaking of. The man in charge of the machine was away for whole days, so that there was no supervision except in the morning and the evening. The capacity of the accumulator battery is sufficient to supply the maximum amount of energy required during 48 hours. As regards the economical side of the question: The first cost at Askov has been about 16,000 Kr. (a Kroner is about 1s. 1d.), out of which 3,000 Kr. are set aside for the cost of petroleum motor. The electric current is supplied to consumers at the same price as in Copenhagen. The receipts for energy sold work out at about 2,800 Kr., and the expenses at about 800 Kr. per year. There will thus remain 2,000 Kr. for the amortization of the plant, which is more than sufficient with a capital of 16,000 Kr. The price of energy could, therefore, be further diminished. In the case of small electricity works intended for the use of a limited number of houses, the petroleum motor may be

replaced by a horse-driven contrivance. Moreover, in the case of the proprietor of the works being his own consumer, the consumption of current may be regulated according to the actual intensity of the wind; in the case of calm weather, there will, for instance, have to be no threshing done, etc. The first cost will thus be considerably diminished; according to Prof. Latour's calculation, a plant suitable for a farm would be installed at a cost of 3,000 to 4,000 Kr.

A CHEAP AUTOMATIC SEWAGE SYSTEM.

By J. A. Macdonald, Student Member C.S.C.E.

The system here illustrated is one particularly adapted to sink draining in rural and suburban homes. It is also well suited to the needs of cheese factories and creameries, where large quantities of slops accumulate daily, and must be hygienically disposed of. Its simplicity and cheapness, requiring no expensive valves for flushing, makes it more desirable in many cases than the septic tank. It is suitable for heavy clay soils, where the septic tank system might not be able to absorb the sewage. It is probably the parent of the septic system, as it has been in use for twenty-five years. W. P. Sissons, of Union Springs, N.Y., has used it for that time with satisfaction. Cleaning is necessary only once in four or five years.



A, Sink. B, Gooseneck pipe leading to tank out of reach of frost. C, Siphon inside of tank, the longer leg extending through bottom of tank. D, Tank holding 100 to 1,000 gal. as required, of plank or brick, and water-tight, may be placed in cellar for domestic purposes. E, covered drain leading from siphon underground to any convenient outlet. F, Ventilating pipe leading from tank to some height, say to house roof. Note. Crook of siphon should not reach quite to top of tank.

The action is entirely automatic. When the tank fills up to the top of the siphon, the siphon empties the tank to within a few inches of the bottom. As solids sink to the bottom and soapy and greasy matter float on the top, the siphon draws off nearly clear water, its mouth being below the surface and a few inches from the bottom. Gases arising from the tank are prevented from coming into the house by the "water seal" of the gooseneck. The ventilation pipe carries off gases and lets air out or in when the tank is filling or emptying. Occasional scalding of the sink with boiling water renders the sink and pipe above the gooseneck free from taint, and cleaning out the tank once in four or five years is found to be by no means a disagreeable job.

Hermanville, P.E.I.

RAILWAY NOTES.

Work on the new railway connecting Elmvale and Midland will be commenced shortly.

The G.T.R. has bought $8,000 worth of property in Waterloo, to be used for extra yard room.

The Railway Commission has approved the plans for the C.P.R. extension from Guelph to Goderich.

A test shaft at Detroit has been examined, and it is reported that a railroad tunnel under the Detroit river is perfectly feasible.

The J. C. Risteen Company, of Fredericton, have gone into the manufacturing of canvas canoes, and it is said that the prospects are that a large business will be done in this line.

The time has expired for the acceptance of Stratford's franchise by the Radial Railway Company, and the scheme has evidently been abandoned.

A by-law granting a $4,000 bonus to the Guelph and Goderich Railway was carried at Elmira. A similar by-law for $7,000 in Woolwich township was defeated.

There are prospects of the C.P.R. being extended to Elmore, Assa., this year. An engineer has been looking over the ground between Lyleton and that place.

Tenders for the purchase of the Quebec Southern Railway system will be received up to August 3rd, by L. A. Audette, Registrar of the Exchequer Court at Ottawa.

A premature explosion of dynamite on the C.P.R. Sudbury-Toronto line, now building, killed seven men, one of whom was the walking boss, H. Poole, of Wakefield, Que.

The Grand Trunk is about to lay a third track from Toronto to Hamilton, to be used for freight purposes only. It will be necessary to expropriate right of way in some places.

By the end of the year the Montreal Street Railway will have placed in service one hundred new cars. The company will also spend a large amount in relaying its tracks with heavy steel rails.

The property of the Guelph Biscuit and Confectionery Company has been bought by the C.P.R., and will be cleared for yard accommodation. The company has options on other property in the neighborhood.

The Hamilton, Grimsby and Beamsville Electric Railway may at last be extended to St. Catharines. Negotiations are being carried on for the use of the proposed high level bridge to enter St. Catharines.

It is expected that the C.P.R. will make a new issue of common stock shortly. Those close to the directors say that the amount will be $20,000,000, the whole of which will be needed for extensions and equipment.

The C.P.R. now holds about $400,000 worth of property in Montreal, just east of Viger Station, and as soon as permission to close certain streets is obtained, the company will extend its yard to provide better shipping facilities.

It is stated that negotiations are in progress for the purchase of the Tillsonburg, Lake Erie and Pacific, by the C.P.R. As soon as the line is in the hands of the C.P.R. it will be overhauled, and equipped with new rolling stock.

The Grand Trunk has bought 200 acres of land at Mimico, and will establish a freight yard there to relieve the Toronto yard. The land is just west of Mimico Station, and tracks are to be extended on both sides of the main line to form a distributing centre for freight. The plans call for a roundhouse also. Details have not yet been arranged. It is said that this yard will be used for east-bound freight and Little York for west-bound.

James Wilkinson, of Birmingham, Ala., is said to have obtained a patent on a turbine as the motive power for a railroad engine. The inventor claims that he can make use of his turbine for railroading with all the economies and conveniences which this system shows on shipboard, and that his engine is suited for light and heavy traffic. He is about to equip a plant in his native city for the construction of turbine engines for all kinds of service.

We believe there is good ground for the rumor that the Grand Trunk, or Grand Trunk Pacific, have come to terms with J. R. Booth, for the acquisition of the Canada Atlantic Railway. Joseph Hobson, chief engineer of the Grand Trunk Railway accompanied Geo. A. Mountain, late chief engineer of the Canada Atlantic Railway, over the line to Depot Harbor the other day, and it is probable that the matter will be settled this month. The Grand Trunk has an Ontario subsidy for a branch to connect Port Arthur with the Grand Trunk Pacific main line, and by building west the grain trade of Manitoba could be tapped before the main line of the Grand Trunk Pacific is completed. There has been a contest between the Canadian Northern and the Grand Trunk for the possession of the Canada Atlantic Railway.

A Greenwood, B.C., paper says: Mr. J. W. Stewart has been awarded the contract for the construction of the extension of the Great Northern Railway, from Morrissey to Fernie. The work will be rushed, as the Great Northern is anxious to secure connection with the coke ovens at Fernie.

Hamilton has won its case against the Hamilton Street Railway Co. in the matter of the city's percentage of railway earnings. Judge Meredith has held that "gross receipts" in the agreement of 1892 included traffic receipts not yet earned, such as receipts from sale of passenger tickets still outstanding.

The Hamilton Radial Electric Railway Company expects to have the Oakville extension graded and in shape to receive the ties and rails by October 1st, and to have the railway completed and cars running before the end of October. The Radial will make connections at Oakville with the Mimico Electric Railway, which is also expected to reach that town this fall.

A storage battery was recently installed in Port Arthur in connection with the railway. The plant cost $6,000, and was supplied by the Gould Storage Battery company, of New York, in competition with other works. The building in which the plant is located is said to be the most complete of its character in the continent.

Arthur Koppel, manufacturer of Industrial, Narrow and Standard Gauge Railway Materials, of 66-68 Broad Street, New York, has an exhibit of track switches, turntables, cars of various styles, etc., at the St. Louis Fair. His exhibit will be found in the Building of Mining and Metallurgy, Block 20, Assignment 10, and visitors will receive a cordial welcome.

Application will be made at the next session of the Legislature to allow the St. Catharines, Pelham and Welland Electric Railway Companies to extend the line from the present terminus at Pelham, through the townships of Pelham and Wainfleet in Welland, and Gainsborough in Lincoln, and Moulton in Haldimand County, to a point within the town of Dunnville.

The case of the Preston & Berlin Railway Company against the Grand Trunk Railway Company for a perpetual injunction to restrain the latter from trespassing on or crossing the P. & B. tracks on Caroline Street, Waterloo, has been settled out of court, the G.T.R. admitting that they had no right to cross the P. & B. tracks without an order from the Railway Commission. The case will come up before the Railway Commission in the near future.

The Grand Valley Company have decided to erect a new power house for their radial line running from Galt to St. George. The site chosen is between Paris and Blue Lake, two miles out of Paris. It is likely that the new power house will be the main one for the whole system. The plans call for a building seventy-one feet by forty-seven. The contract has been let to Messrs. P. D. Secord & Son. The power house will be completed as soon as the lines to Galt and St. George are in working order.

General Manager H. W. Gays of the New York and Ottawa Railway, says that the experts who were engaged to make a report as to changing the road from Ottawa to Tupper Lake, N.Y., from steam to electricity, estimate that the cost would be nearly a million dollars. This is a large outlay and Mr. Gays says that even if the road was fully equipped electrically, unless there was three times the number of trains run on the line than there are now, steam is the cheaper motive power. The change will therefore not be made at present.

The Montreal Terminal bill asking for power to run electric railways through the counties of Hochelaga, Maisonneuve, Jacques Cartier, Laval, Terrebonne, L'Assomption, Montcalm, and Joliette has been thrown out by the Railway Committee of the House of Commons. J. P. Mullarkey, made a strong plea on the prospect and said the company had spent $1,400,000 on a line to Joliette, and was prepared to go on. It was the only line that gave a two and one half cent passenger rate in Montreal. The application for a charter for the Canadian Traction Power Company, behind which are the same capitalists, was withdrawn. This company proposed to run a line up the Ottawa valley.

It is stated that an arrangement has been made for the permanent operation of the New Brunswick Coal and Railway Co.'s line on a firmer basis than heretofore. W. J. Hunter, now with the Intercolonial at Moncton, will become superintendent of the first-named road.

The Great Northern Railway of Canada failed to meet the interest on its bonds due on July 1st. It is said in explanation that negotiations are pending for the amalgamation of this line with the Chateauguay and Northern Railway and the reorganization of the company's business, involving the paying off of the present floating debt and outstanding bonds and the issue of new first mortgage bonds. By the amalgamation the Great Northern would secure entrance to Montreal, and the plan provides for the building of two or three connections, one of which is from Garneau Junction to Quebec, a distance of seventy-five miles. As soon as physical connection is made between the Great Northern and the Canadian Northern, it is said that a general amalgamation will occur.

The Canadian Pacific Railway will build this summer at its shops in Perth, one hundred stock, and eighty-five flat cars of 60,000 pounds capacity, and twenty-five refrigerator cars. The stock cars will be thirty-six feet long, eight feet, eight inches wide, and seven feet one and one quarter inches high, inside measurements. The flat cars will be thirty-six feet eight inches long, eight feet ten inches wide over frame and four feet two inches high from rails to top floor. The refrigerator cars will be thirty-eight feet eight inches long, and eight feet eleven inches wide over frames. The special equipment for all includes M. C. B. axles, Simplex bolsters and patent side bearings, Simplex brave beams, Westinghouse air brakes, Tower couplers, Miner draft rigging, dust guards, journal boxes and lids and roller side-bearing trucks.

The Canadian Electric Traction Company has awarded a contract to Bruce, Peebles & Co., of Edinburgh, for ten motor cars, with a speed of thirty miles an hour on the level, and fifteen miles an hour on grades of one in twenty-five. Each car will have a capacity for fifty passengers, and is to be capable of hauling either freight or a passenger trailer in addition. The motor equipments will be of two hundred and fifty horse power each. The power house equipment will have a capacity of 1,000 horse power. The value of the contract is £42,250. Power will be transmitted at 10,000 volts, and 25 frequency, and will be transformed to 1,000 volts for the motor cars. The use of the Ganz system, which is the polyphase system to be adopted, the manufacturers claim, will show a saving of thirty per cent both in first cost, and operating costs, when compared with a single phase or a continuous current equipment. The line will run from London, through St. Thomas to Port Stanley, a distance of thirty miles. As soon as this section is completed, the remaining portion from London to Hamilton, will be electrified on the same system, making, in all, a distance of 160 miles.

MARINE NEWS.

A motor boat association is being formed to include in its membership all owners of motor boats from Kingston to Ogdensburg.

The lightship Anticosti, No. 15, built by the Polson Iron Co. for Dominion Government service, has left for her station at Anticosti Island.

The steamer Edna was damaged by fire at Parry Sound on July 13th, to the extent of about $1,000. She belonged to the Parry Sound yachting fleet.

The steamer Jubilee, running on Lake Temiskaming, Ont. ran into the wharf at Haileybury, Ont., recently, and sank during the night, and a number of her passengers had narrow escapes.

On July 13th, the steamer Lunenburg, from Ingonish, C.B., for North Sydney, struck on the rocks near Cranberry Head. Attempts to float the steamer were unsuccessful, and it is likely the hull will be abandoned. Passengers were landed, and the cargo is being removed.

The steamer Gauss, recently purchased by the Dominion Government for service in the Arctic seas, has been renamed the Arctic, and is being refitted and equipped for her work at Quebec.

A new steamer named the Elgin L. Lewis, for the freight and passenger trade on Lake Simcoe, has been launched at Orillia, Ont. She will have accommodation for 125 passengers.

It is reported that H. Calderwood, manager of the Collingwood Ship Building Co., has resigned. Jas. Smith, mechanical superintendent, and F. Johnston are also reported to have resigned.

The Ottawa River Navigation Co.'s steamer Empress has been put on her run to Grenville, Ont., after having been re-engined, and her passenger accommodations rearranged and improved.

Announcement from Vancouver, B.C., has been made that a new turbine steamer is to be built for the British Columbia-Australian service. She will be one of the fastest steamers on the Pacific.

On July 12th, the steamer Athenian collided with the Verex in the St. Lawrence, opposite St. Laurent, striking her above her engine and cutting her almost in two, from the keelson to the bulwarks.

The steamer Mary Hough, recently brought out from Liverpool, Eng., by Bowring Bros., Ltd., St. Johns, N.F., for the west coast run, ran on the rocks and has become a total loss. The steamer Restigouche, owned by the North American Transportation Co., has been chartered for the service.

The Dominion Atlantic Railway has placed one of its steamers, the Prince Arthur, on a route from Halifax, N.S., to New York, and the Red Cross Line, which heretofore has not had any competition, has cut the rate to $15 single and $25 return.

The Polson Iron Works Co., Toronto, proposes starting the construction of motor boats, and is acting as agent for the Thorneycroft firm of London, Eng. A sample motor boat making twenty miles an hour has been brought out by F. B. Polson, who has just returned from England.

A. Spence, of the Gainsworth Dock Company, which owns shipbuilding yards on both the Forth and Clyde, and is one of the largest shipbuilding firms in Scotland, has been looking at the proposed site for steel shipbuilding at Dartmouth Cove, N.S., and considers it excellent.

The Richelieu & Ontario Co. steamer Carolina ran on a reef in Ha-Ha Bay on July 15th, sustaining some injury in the bow, but was able later to proceed to Levis under her own steam. The Carolina ran aground last year, and was almost entirely rebuilt after that accident.

A deputation waited on the Prime Minister on July 14th to urge the building of the Ottawa and Georgian Bay Canal. Sir Wilfrid gave the deputation assurances that he was in favor of the Government building the canal, and that the matter would receive immediate and serious consideration.

In competition with all the important shipbuilding companies on the Pacific coast, the Victoria Machinery Depot has made a successful tender for repairing to be done on the Algoa, a Pacific mail liner, which struck on Point Bonilla, off the California coast. The liner is 455 feet long, and of 7,000 tonnage. Repairs are to be made to the bottom, which is badly damaged, and also to the machinery.

The steel barge Haddington was launched at the John Bertram shipyards recently. The Haddington is intended for carrying grain and package freight between Fort William and Montreal, and is of canal size. Her dimensions are 254 feet long, 42 feet beam, and 18 feet deep. She is fitted with two Scotch return tubular boilers ten feet in diameter and 11 feet long. Her engines are of the triple expansion type, with cylinders of 15 inches, 25 inches and 42 inches diameter respectively, and 30-inch stroke. On the deck will be six three-ton deck cranes for handling freight. The capacity of the steamer is 75,000 bushels of wheat, and its total cost is $130,000.

The charter of the Montreal, Ottawa & Georgian Bay Navigation Co. has been extended for two years.

Steamer Hibernian, before reported ashore near Codroy, was floated on the 8th by the Merritt & Chapman Wrecking Company. The vessel will probably be dry docked at St. Johns, Newfoundland.

The Department of Marine and Fisheries, Ottawa, is asking tenders for the construction of two wooden lighthouse towers to be erected at Point Edward, in Sydney Harbor. These towers are to be equipped with range lights. The work of construction will likely begin about the first of August.

In 1902 D. O'Connor placed a small steamer on Lake Temagami, seventy-two miles north of North Bay, Ont., for freight and passenger trade. The increasing trade of the district, due to settlement and tourist travel, has necessitated the addition of a second steamer. This is an 85-foot boat, and was purchased at Kingston.

Capt. C. T. Knowlton, with crew has sailed to England to bring over the new Government steamer Canada, recently launched at Vickers Sons & Maxim's Yard, Barrow. The Canada will take the place of the Acadia, as flagship of the fishery protection service. She is two hundred feet long, and is armed with four pom-pom guns.

Owing to the claims for salvage brought against the Allan line steamer Austria, which was damaged in the recent fire at Boston, the work of temporary repairs has been held in abeyance, and it is possible that the vessel may be sold at that port. One claim placed the value of the craft at $100,000, and the cargo in her at the time at $200,000.

A new type of boat is about to make its appearance at Hamilton. The craft is a torpedo-stern speed launch, thirty feet long and less than five feet beam. She will be fitted with a twenty-one horse power gasoline engine, and is expected to develop a speed of seventeen miles an hour. She is being built by Mr. Turner, of the Smart-Turner company.

A Tacoma, Wash., despatch says that Capt. Finch, manager of the Neptune Salvage Co., has located the wreck of the Canadian steamship Islander, which sank in Alaska water in August three years ago. He expects to raise the Islander and recover the treasure boxes and valuables aboard her, which are estimated at from $400,000 to $700,000. The vessel was located by using a big steel diving cage, invented by Capt. W. W. Smith, of Milwaukee.

A Victoria paper says: "Capt. Newcombe, of the Government steamer Kestrel, reports a remarkable performance of the new propeller lately fitted to his ship. After three months' experience of its work, he claims a total absence of vibration and a knot per hour increase of speed, with the same revolutions of steam pressure. This is equivalent to an increase of thirty per cent. in engine power. The new propeller is a two-ton bronze casting, and was designed for the Kestrel by James K. Rebbeck, consulting engineer, and cast by Alex. Stewart at the Albion Iron Works, in this city.

The steamer North Star of the Mutual Transit Company, arrived at Port Arthur from Cleveland on July 6th, and discharged 400 tons of freight at the C.N.R. dock for shipment to the Northwest. This is the first break of the American lines into the carrying of freight to the Canadian head of the lakes. The company have contracts for the hauling of a large amount of freight from Cleveland, Buffalo and other American ports to Port Arthur and Fort William for shipment west. There are seven steamers in the fleet, and each of these will call en route to Duluth.

The new White Star liner Baltic has made her maiden trip from Liverpool to New York and return. On her return trip she demonstrated that she is some years ahead of the facilities of the port of New York. Her draught when loaded to her full limit is 36 feet 6 in., while the port's limit is 30 feet, except at high water, when vessels drawing 32 feet may enter or leave the harbor. When the Baltic is loaded to the draught limit of New York harbor she is still 4,500 tons below her full capacity; that is, she has about an average tramp steamer's capacity for which she has no employment.

MACHINE SHOP NOTES FROM THE STATES.

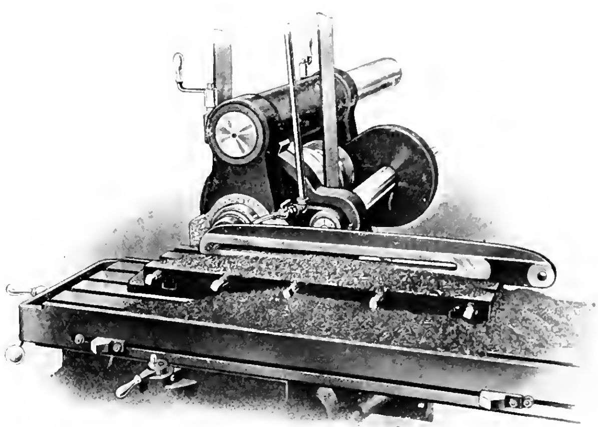
By Chas. S. Gingrich, M.E.

VI.

Automobile Manufacture.

There is probably no branch of the mechanical industries that is as busy at the present time, as the automobile manufacturers. Although this business is comparatively new, and the process of duplication of parts has not yet been carried out as thoroughly by any means, as in the bicycle business, it is nevertheless surprising to note the system that prevails in the manufacture of these machines, even in factories where no permanent model has yet been decided upon.

Standard automatic machines are largely employed on small parts, and wherever metal is to be surfaced off of



castings, large or small, this is done by machines and methods adapted for doing it in the quickest possible manner. A notable example of this is shown in the accompanying illustration, which shows the engine frame of a well-known automobile manufactured in Ohio, mounted on the table of a Cincinnati geared-feed miller, in process of being finished. The surface is about 10 inches wide, and is being finished at one cut with a 10½-inch diameter face-mill which is feeding .3 inches for every turn of the cutter, with a resulting table travel of 5¼-inches per minute. The actual time required for taking the cut is a little over four minutes, and the operator requires about 10 minutes for chucking and handling the pieces, at which rate one engine frame is easily finished every fifteen minutes.

Several years ago it would not have been considered practicable to do work in this manner, and a shaper or small planer would have been used instead, and of course, the time for finishing the job would have been at least double the time that is required by the method mentioned above.

(Continued on page 240.)

LITERARY NOTICES.

The Naval Pocket Book, 1904; 16mo.; pp. 972. Edited by Sir Wm. Laird Clowes. London: W. Thacker & Co., 2 Creed Lane, E.C.; 7s. 6d. net.

This publication, which is now in its ninth year, is designed to give technical information about the navies of the world. Special interest attaches to this number, as with it Sir Wm. Clowes resumes active editorship. The book contains a complete list of the ships of the navies of the world, giving the displacement, armament, protection, engines, coal capacity, etc.; an index of ships by name, and plans of over a hundred ships of all navies. Allan H. Burgoyne, F.R.G.S., contributes a chapter on the history of the submarine, and full particulars of the submarine fleets of the world are also given. Another chapter is devoted to a full description of the various types of torpedoes in use. A detailed list of the dry docks of the world is supplied. Miscellaneous tables, trial-trip tables, etc., make up the complement of information in this small but copious book.

Up-to-date Tables of Weights, Measures and Coinage. Alfred J. Martin, Fellow of Surveyors' Institution, England. London: T. Fisher Unwin, 1904; 16mo., pp. 250.

This little book goes very thoroughly into the matter of weights, measures and coinage as now existing in the Empire. Information as to present units and their relations is full and complete, but the main purpose of the book is the advocacy of the adoption of the metric system. The book contains a historical sketch of advances made along this line in various parts of the Empire within recent years, coming down to the introduction into the Imperial Parliament of the Metric System Bill of 1904. The author does not advise a sudden change, but rather an adjustment of the system at present in use to a scientific basis. "Advocates of the metric system should remember that all British reforms come by evolution, not revolution. Britishers prefer being led to being driven. Tell them that their cumbrous system will be adjusted, and they will listen; but tell them it will be bundled out, and a foreign one take its place, and they will turn a deaf ear." A large part of the book is devoted to an exposition of a simple, practical, and yet accurate adjustment of the present system to the metric system. A method of decimalization of British coinage is also explained. Reforms of a practical nature in time, mariners' compass, etc., are advocated. A mass of useful information for office and workshop is also contained in the book. A 50-page supplement accompanies the book, containing a guide to simple arithmetic, and showing how decimals may be taught at a very early age.

International Fire Prevention Congress, London, 1903. Report of Proceedings by J. H. Woolson, E.M., Adjunct Professor Mechanical Engineering, Columbia University. New York: Martin B. Brown Co., 1904.; 12mo., pp. 250.

Prof. Woolson was the official representative of New York City to the Fire Prevention Congress at London last July, and his report is published by the city authorities. It is said to be the only report issued in America containing a complete digest of the proceedings, so far as construction and protection are concerned. The book contains twenty-one papers presented to the congress by eminent authorities from all parts of the world on various phases of the problem of fire prevention. Diagrams and views of the British

Fire Prevention Committee's testing station are included in the book. Engineers, architects and others should find much useful information in this book.

The Iron Age Directory, 1904: A classified index of goods manufactured by advertisers in the Iron Age. New York: David Williams Co.; pp. 300; 25 cents.

This handbook should prove very useful to buyers of all kinds of materials and products connected with the iron business. The list is an index to the makers of over 5,000 different tools, machines and products. As the list is classified under the names of products, all the makers of any particular tool may be found at a glance.

Easy Lessons; or, the Stepping-stone to Architecture. By Thomas Mitchell; 12mo., pp. 100; 50 cents. New York: Industrial Publication Co.

This book is an elementary treatise on architecture in the form of question and answer. It treats of architecture from its earliest beginnings to modern times, but necessarily in a rather cursory way. The ground is taken that a knowledge of architecture should form part of every liberal education, and the book is written with the object of supplying the information to meet that need. It is profusely illustrated.

MUNICIPAL WORKS, ETC.

Thamesville is about to install a waterworks system for fire protection and private use.

Kincardine has carried a by-law to raise $4,500 to extend the electric light and waterworks systems.

Picton has voted down money by-laws to erect municipal buildings, and to buy electric light and waterworks plants.

C. F. Gildersleeve, of Kingston, has secured the contract to extend the sewage system in St. Catharines. His tender was $31,232.

Montreal city council has granted to Theo. Leclaire, the contract for the construction of a four-foot circular sewer from the sewage farm to Riviere des Prairies, a distance of about sixteen hundred yards.

The municipality of Bordeaux, near Montreal, has passed a by-law to borrow $25,000 for a waterworks and sewage system for the village, which is situated on the Back river at Sault au Recollet rapids.

Almonte town council has decided to commence on August 1st, the development of electric light power. The electric light committee will proceed with the construction of a cement bulkhead and side dam.

After having been cut off for three months, the electric current has been turned on the power motors in Orillia. The power is derived from an auxiliary steam plant which the council has installed at a cost of $10,000. Work on the repair of the broken dam at the Ragged Rapids has been commenced under the superintendence of D. C. Clark, of Trenton, and is expected to be completed early this fall. Meantime, the auxiliary steam plant supplies the town with light as well as with power.

Kingston is to acquire the plant of the Kingston Light, Heat and Power Co. on August 1st on the following terms: The city takes over the plant, subject to the debentures, $99,975, which mature in 1917, with interest from August 1, 1904, and shall pay the company the balance of the $170,373 named in the by-law. The company pays taxes on plant to August 1, 1904, and costs of all appeals against the award. The city also pays $3,857 for additions made to the plant since 1901, the time the arbitration was had. The city gives the railway company power at $2 a day for each car for six months, and after that at a rate to be agreed upon. J. M. Campbell has been appointed supervising engineer of the plant.

The Crow's Nest Pass Coal Company recently ordered from the Robb Engineering Company two 175 horse-power Robb-Mumford boilers for their mines at Fernie, B.C., in addition to three of the same style installed last year.

H. A. Kribs, chief engineer of the R. Forbes Co. woolen mills in Hespeler, was badly scalded through the bursting of the engine feed-pipe on July 25th, and died of gangrene on the 28th. Deceased leaves a wife and two adopted children. Four years ago his brother-in-law was killed in the same factory.

The Lindsay, Bobcaygeon and Pontypool Railway, just completed, has been taken over by the C.P.R. under perpetual lease, and will be opened for traffic on August 1st. The line is thirty-eight miles long. It leaves Burketon Station, on the C.P.R. main line, and runs north-east through Lindsay to Bobcaygeon.

—The Iron and Steel Company of Canada, Limited, of Belleville, successors to the Abbott-Mitchell Iron & Steel Company, started up their railing mills at Belleville on the 18th of July. The works had been closed for three or four years. J. F. Wills is managing director of the new company, whose present output will be in bar iron, washers and all kinds of spikes.

The Mechanics' Supply Co., 80-90 St. Paul Street, Quebec, have got out an ingenious watch charm in the shape of a draw-knife, which will be mailed to any address on receipt of thirty cents. This is another of the series, among which are a monkey-wrench, hammer, machinists' clamp, etc. Each of these souvenirs has had a large sale.

—Contracts for the construction of the James Bay Railway from Toronto to Parry Sound have been let by Messrs. Mackenzie & Mann. The contractors are Angus Sinclair, C.E., and the firm of A. R. Mann & Archie Mackenzie. Mr. Sinclair, who has the construction of the Parry Sound end of the line, has just finished the construction of one hundred miles of work for Mackenzie & Mann, including grading and masonry, in Nova Scotia. Messrs. A. B. Mann and Archie Mackenzie have been engaged on several contracts for the Canadian Northern in Manitoba and the West. The contracts made stipulate that the work shall be completed in September, 1905. The contract for the line from Parry Sound to Sudbury will probably be let shortly.

—J. V. Welch, operating the New Ontario gold mine, four and a half miles east of Fort Frances, has found free milling gold far in excess of his expectations. It is said that other minerals, including platinum, are to be found on the property.

—At Panama the highest mast in the world for wireless telegraphy is being erected by the De Forest Company. This company claims that wireless communication with the Orient will soon be established through a chain of stations at Seattle, Cape Flattery, Dutch Harbor, Kamchatka, Japan and Wei-Hai-Wei.

W. J. Webb, for the past six years engineer and superintendent of the Lawlor Building, corner of King and Yonge Streets, Toronto, has accepted a position as superintendent of Winnipeg's new eleven-storey sky-scraper, the Union Bank Building. Mr. Webb will be missed in engineering circles in Toronto, as he has occupied many executive positions in both the Canadian and Ontario Associations of Stationary Engineers. He reports at Winnipeg on the 15th of August.

THE STATISTICS OF CANADIAN PROGRESS IN ELECTRICAL APPLICATIONS.

By Geo. Johnson, Dominion Statistician.

The 24th of May will be the sixtieth anniversary of the sending of the first Morse message over a telegraph wire.

There are now 1,764 private and government cables with a length of 204,527 nautical miles.

On the land there are 1,025,700 miles of line and 3,978,500 miles of wire. These represent an outlay of capital equal to 500 million dollars. Add the outlay for cables and there is a total outlay of 850 million dollars to provide the means for transmitting wire messages by sea and by land.

Over head and under seas there is a daily transmission of one million four hundred thousand telegrams and 36,000 cable messages; the totals being 478,330,000 land messages and 13,140,000 cables in the year 1903.

This is the minimum, for in South Africa (for instance), there are thousands of miles of line which are in the hands of companies that are not required to make returns. Another fact has to be taken into consideration and that is that these figures do not include the telegrams sent by railways in the management of their own business. These number many millions in the course of the year. Thus Russia, in 1902, included the telegrams despatched hither and thither over that vast country in connection with the running of her railways, and the result was a total of 101,639,542 telegrams, whereas in the year before (1901), when railway telegrams were not included, the messages sent numbered only 20,000,000.

A third fact must be kept in mind. In Canada the press messages are not included in the number reported. Everyone knows the important part the newspaper telegraph service plays in such a country as Canada. Divided by ten to represent an ordinary message the millions of words of the "flimsy" of the press would far exceed the other messages sent and delivered in the course of the month or year and representing the business, the social and the other activities of the country. No estimate can be made of the number of these messages. It is plain, however, that at least a million four hundred thousand messages pass to and fro every day of the three hundred and sixty-five days of the year. All this from the one or two telegrams which passed on the 24th May, 1844, when the Morse system turned the plaything of science into an instrument of practical, everyday use.

The countries which most use the telegraphic mode of communication are the British Empire, the United States, Germany, France, Austria-Hungary.

The British Empire has 218,000 miles of line, nearly one million miles of wire, and sends and receives 127,000,000 messages.

Great Britain despatches and receives 92,471,000 messages or 222 per 100 of her population. Her daughters follow her illustrious example. Australia even goes beyond her, sending 223 messages per each one hundred, while New Zealand, that wonderful sister under the southern cross, goes far beyond mother, sisters, cousins, aunts or anybody else, topping the list with 610 telegrams per one hundred of her population. Canada does not make a good second, her record being only 101 messages per one hundred of her population. The African possessions of the British Empire, notwithstanding the fact that only a comparatively small proportion of the messages actually sent, are included in the available statistics exceed in the per head number, the record of Canada.

Of outside nations, Belgium holds the record, her telegraphic messages numbering 207 per one hundred of her population. Argentina comes next with 146 messages per one hundred of her population. The United States does better than Canada, having 120 messages per each one hundred of her population. France slightly exceeds the United States with 121. Germany is considerably below the other principal countries, having a record of 80 messages for each one hundred of the population. In the matter of miles of wire, Canada somewhat exceeds the United States. If the latter had as many miles as the Dominion in proportion to population, it would have over 200,000 miles more than it has.

The table being Appendix "A," gives as complete a list as I have been able to make up.

The employment of electricity, that subtle fluid of whose properties we know much without knowing anything of itself is by no means limited to the circulation of telegraphic messages among the nations of the world.

Electrical Propulsion.

It is about sixteen years since the scientific practicability of propulsion by means of electricity was proved beyond dispute.

In the United States there are to-day about eleven hundred street railway systems,* the motive power of which is electricity. There are 25,800 miles of track, the capitalization is $1,630,000,000, and the funded debt $1,275,000,000; the earnings were over $240,000,000 last year. Our neighbors have made great progress. They have 322 miles of electric railway to each million of the population of continental United States. These carried 5,000,000,000 persons or about 65 times the population, and about eight times as many as the steam-driven railways. Canadians have no cause to feel inferiority. Our electric railways carried last year 167,704,000 passengers or about thirty times the population of the Dominion. When it is recollected that the urban population of the United States forms over 37 per cent. of the whole, while Canada's town population is only 26 per cent., it is evident that our electric railways come out well in a comparison and give promise of doing better in the future, as Canada's urban population, following the continent's trend, increases its proportion. Our electric railways carried, like those of the United States, about eight times as many passengers as our steam railways carried.

I believe that Hamilton claims the honor of being one of the first cities in Canada to adopt electricity as the motive power of street railways, the Hamilton Street Railway Company having been equipped with electricity in 1892, the Ottawa Electric Railway Company beginning its career in July, 1891. Our development is, therefore, all within eleven or twelve years. That of the United States began in 1898.

Electric Railway Statistics of Canada.

The following table gives particulars of electric railway companies during the years ended December 31st, 1901-1903:

	1903.	1902.	1901.
Total number of railways sending returns	46	44	43
" miles of track, single	454.75	421.30	376.35
" miles of track, double	192.54	188.00	179 10
" motor cars	2,053	1,895	1,853
" trailers	208	326	302
" snow-sweepers and ploughs	109	97	85
" miles run	39,721,153	36,711,130	34,547,075
" passengers carried	167,703,958	145,600,093	132,885,258
" employees	7,439	5,427	5,443
Total amount of capital paid up	$29,838,326	$25,961,254	$24,734,040
" bonded debts	$17,013,758	$15,704,408	$14,106,225
" gross earnings	$ 7,777,324	$ 6,805,007	$ 6,283,606
" gross expenses	$ 5,018,779	$ 4,140,490	$ 3,699,283

*In 1900 the United States Census Returns for 1899 gave 871 street railways, chiefly electric.

Mileage in Each Province in 1903.

	Single Track.	Double Track.
Ontario	273.14	87.64
Quebec	96.09	82.57
British Columbia	41.75	6.25
New Brunswick	10.06	2.50
Nova Scotia	23.71	1.58
Manitoba	10.00	12.00
Total	454.75	192.54

The following table gives the number of employees, passengers and others killed and injured on electric railways in Canada for the year ended June 30th, 1903, also totals for 1902:

Causes.	Employees. Killed.	Employees. Injured.	Passengers. Killed.	Passengers. Injured.	Others. Killed.	Others. Injured.	Total. Killed.	Total. Injured.
Falling off trains	2	18	..	71	..	..	2	89
Jumping off trains	..	..	5	318	..	2	5	320
Struck by engine or cars	1	..	3	42	8	117	12	159
Head out of window	..	..	..	3	..	..	..	3
Coupling cars	..	6	..	..	..	..	..	6
Collisions	2	24	1	34	..	26	3	84
Walking on track	..	1	..	18	13	57	13	76
Other causes	2	13	1	18	1	10	4	41
Total, 1903	7	62	10	504	22	212	39	778
" 1902	2	30	8	413	22	120	32	563

In the Statistical Office we began to obtain returns in 1898. The following is the return for that year:

Number companies sending returns	35
Total number miles of track	635
Number of cars	1,379
" " trailers	382
" " snow-sweepers, ploughs	69
" " miles run	28,547,908
" " passengers carried	94,616,344
" " employees	4,004
Total amount capital paid up	$18,309,876
Bonded debt	10,454,452

I think that there was some misunderstanding about the miles of track. Otherwise the return for 1898 appears to me to be fairly correct. In 1900 the return gave 688 miles. In 1901 we asked for the miles of track, single and double, in order to eliminate the apparent confusion, and obtained as the result answers which aggregated 555½ miles. The latest return gives a total of 647.29 miles, showing an increase of 92 miles since the new century came in.

Telephones.

The summer of 1904 is the 30th anniversary of the invention of the telephone. In 1874, Mr. Graham Bell, then on a visit to his parents, who lived in Brantford, made some laboratory experiments which proved that speech could be transmitted by wire. Two years later, August, 1876, the first transmission of speech over a telegraph wire took place in Brantford. In 1877 the telephone went into commercial use, this city of Hamilton being the first to establish it. From that beginning the use of the telephone has been constantly on the increase. The first returns the Statistical Office secured showed that in 1893 Canada's equipment was 44,000 miles of wire; 33,500 instruments, by means of which 72,500,000 messages were sent in the year. In the ten years since the number of instruments has increased to 81,500 and of messages to 253,970,000, an increase of 144 per cent. in instruments and of 250 per cent. in number of messages—instruments 1 ½ times more; messages 2 1-2 times more.

Taking the population of the last census there is in Canada one telephone instrument to every 65 persons.

By provinces:

Ontario, one telephone to every	57.9 persons.
Quebec, " " "	63.8 "
Nova Scotia, " " "	99.4 "
New Brunswick, " "	85.3 "
P. E. Island, " "	215.0 "
Manitoba, " "	51.5 "
N. W. Territories, " "	251.3 "
British Columbia, " "	33.4 "

According to our list there were the first of this year 56 companies in Canada, divided by provinces as follows:

Twenty in Quebec, eleven in Ontario, seven in New Brunswick, six in Nova Scotia, one in P. E. Island, two in Manitoba, three in the Northwest Territories, one of these being in the Yukon, and six in British Columbia—the Bell Telephone Co. being counted three times, one in Quebec, one in Ontario, and one in Manitoba. Actually there are fifty-three, and we obtained this year returns from all but seven.

Some of them are, I believe, under the control of the Bell Telephone Company and their returns are included in that Company's returns.

(Just here I may note with satisfaction that all responded to our request with promptitude and showed sympathy with our efforts to procure the statistics published in the Year Book of Canada.)

Our neighbors to the south in 1900 showed a per capita of one telephone in 40, while in some places, such as San Francisco, it had reached one in twelve (U. S. Census Bulletin). The latest statistics indicate a per capita of one in thirty-eight. This rate of progress is exceeded by Denmark, in which country, according to Mr. F. Dagger in the Canadian Engineer, the per capita is one in every fourteen. Canada has not used the telephone to the same extent, but we appear to be making great strides forward, and British Columbia has come within measurable distance of the greatest of telephone-using peoples, the people of Stockholm, in which city there is one telephone in every eight persons.

The Dominion began to construct telephone lines with a commercial end in view, in 1877, as already stated. As far as our somewhat incomplete statistics show, fourteen telephone companies now in operation began distributing "hellos" in the decade 1880-1889; fourteen in 1890-1899 and thirteen in the present decade. Of the remainder we have no record.

The usefulness of the telephone in business in rural communities is well illustrated by the practice in the great fruit growing valley of Nova Scotia. The steamer of Halifax has loaded up with all she purposes carrying of other articles. She is to sail on Saturday afternoon for Liverpool. Her agent telephones to Kentville and Wolfville on Thursday that there is space left for say 2,000 barrels of apples. Kentville and Wolfville telephone to the sub-agents of the London (Eng.) fruit dealers, "How many barrels can you send to Halifax?" These sub-agents jump into their gigs and in an hour have arranged with the orchardists as to the number of barrels to be delivered on Friday evening at each station along the railway. Then they telephone the result to head stations. Cars are provided in accordance. The fruit is shipped to Halifax Friday night, put on board the steamer the next morning and off goes the steamer, the fruit having been exposed to high temperature hardly at all, the orchardists having had ample time to get their barrels repacked, the railway full opportunity to supply the necessary cars and the steamer being able to take on board the freight without exposing it to the influence of adverse conditions of weather on the wharf.

The number of telephone messages per annum for different countries is:

France	187,002,352
Germany	766,226,337
Great Britain and Ireland	723,246,368

Austria-Hungary	147,543,138
Denmark	59,210,855
Belgium	38,753,397
Switzerland	26,670,381
Netherlands	31,460,979
Norway	1,723,347
United States	3,002,000,000

Electric Light, Heat and Power Companies in Canada.

The equipment of these with which Canada has provided herself is of comparatively recent date.

There is no mention made of electricity in the census records of 1881.

In the census of 1891 the following information is given, 1901 being given for comparison:

	Manufacture of Electrical Appliances, Electric Supplies. 1891.	1901.	Electric Light. 1891.	1901.
No. establishments*	13	25	23	58
Capital	$1,520,000	$5,267,397	$3,185,257	$11,891,025
No. hands	408	1,922	630	899
Wages	$ 158,500	$ 846,618	$ 237,348	$ 451,047
Output	801,752	3,032,252	845,134	2,008,017

*Establishments having five hands and over.

In addition, the census of 1891 gave as follows:

Electrical Appliances and Supplies.

(Establishments Having Under Five Employees.)

No. establishments	10
Capital	$43,813
No. hands	17
Wages	$14,615
Output	$63,100

In the census of 1901 no provision was made for the collection of statistics of establishments having under five hands, so that for purposes of comparison, we must take the development which has occurred in establishments having more than five hands.

These show an increase in the ten years, as follows:

Establishments (Electrical Appliances and Supplies.)

Capital	—increase in ten years—	246 per cent.
Hands employed	" " "	346 "
Wages paid	" " "	434 "
Output	" " "	278 "

The statistics of electric light, heat and power plants having five hands have been given before. In addition to these, there were, in 1891, fifty-seven establishments having fewer than five hands, with a capital of $928,514; employees, 133, receiving in wages $60,336, and having an output of $309,015 of finished products.

The total equipment of Canada then of 1891 in light, heat and power establishments was:

Establishments	80
Employees	763
Capital	$4,113,771
Wages	$ 158,500 $ 846,618 $ 237,348 $ 451,047
Output	$1,154,149

Comparing these totals with those of 1901, which include only establishments having five hands, the evidence is strong that there has been a marvellous increase in the development of electric light, heat and power applications in Canada.

The Statistical Office has been able to secure a fairly complete return of the electric light companies for 1903, so that we can give data which enable us to ascertain the extent of the development in twelve years with a successful approach to accuracy.

The first point necessary for a comparison of the equipment of electric light works possessed by Canada is the number of establishments.

By provinces these were in:

Provinces	1891.	1903.
British Columbia	2	17
Manitoba	2	7
New Brunswick	7	13
Nova Scotia	7	22
Ontario	[illegible]	[illegible]
P. E. Island	2	[illegible]
Quebec	9	[illegible]
Territories	2	[illegible]
Total	[illegible]	[illegible]

This is a marvellous development in twelve years. It shows how fully Ontario has entered into the spirit of the age and what a full equipment of the great force of modern times she has provided for herself.

In the 316 establishments of 1903 there were 1,786 hands compared with 762 hands in 1891. There was a capital of over $20,000,000 invested against $3,200,000 in 1891.

Another result of our enquiry was that in the Province of Ontario about 100 of the plants were found to be using coal or wood, about 60 using water-power and 35 steam and water, remainder not stating the particulars. In Quebec six establishments used coal or wood; 38 utilized the water-power of the province, and seven combined water-power and steam-power. In New Brunswick 11 obtained power from coal or wood and 2 from water. In Nova Scotia 16 used coal and 6 water. In Prince Edward Island, 2 coal and 1 water. In Manitoba, 5 coal and 2 steam and water. In the Territories, 4 coal and 1 water and steam. In British Columbia, 8 coal or wood, 8 water and 1 water and steam.

Except in the Province of Quebec the majority of the plants use coal or coal and wood. Sometimes sawdust is utilized.

Electric Lighting in Canada.

An analysis of the statistics of electric lights prepared by me for the Year Book for 1903 shows that in 1903 there were 324 electric plants* in the Dominion with 14,780 arc lights and 1,212,861 incandescent lights. Taking the arc as equal to ten incandescent lights the country had on the 30th June last 1,360,661 lights in use. This is an increase of 236,865 lights in twelve months, or over 21 per cent. Where there were five lights in 1902 there were 6 in 1903. The growth since 1898 has been: Establishments, 1903, 324; increase 65. Arc lights, 14,780; increase, 4,301. Incandescents, 1,212,861; increase, 749,246, showing an increase of 42 per cent. in the number of arc lights and of 161 6 per cent. in the incandescents.

Of the provinces Ontario is far away the chief employer of the electric light. This province had 203 of the 324 plants in use in the Dominion. It has considerably more than one-half the total number of arc lights, and 47 in each hundred of the incandescents. Thirty-four municipalities in the province supply themselves with electric lighting.

The Province of Quebec has 53 plants, 3,853 arc lights and 409,503 incandescents. It is, therefore, behind Ontario by 4,571 arcs and 158,990 incandescents. It has made, however, greater proportionate gain since 1898 than Ontario, the gain in arcs being: Ontario, 30.2 per cent.; Quebec, 47.6 per cent.; and in incandescents, Ontario 138.6 per cent., and Quebec 212.3 per cent. During the period 1898-1903 the number of plants in Quebec increased by 13.

The largest single plant in the Dominion is that of Toronto, with its 170,000 lamps; arcs being taken as each equal to 10 incandescents. The next largest is that of the Lachine Rapids Hydraulic and Land Company, Montreal, 158,503. The third in size is the Ottawa Electric Company, with 111,927 lights.

The other provinces have made considerable progress. To the west, Manitoba has increased in 1898-1903 its arc lights from 102 to 375, and its incandescents from 13,800 to 31,905.

The North-West Territories have not increased as rapidly as the other parts of the Dominion, their arcs num-

*Some of these are absorbed by others but made their returns to the Department of Internal Revenue separately and are therefore given here separately. In the previous tables they are dealt with under the return of the absorbing companies.

bering 29, an increase of 4 in the period named, and their incandescents numbering 6,677, an increase of 1,997.

British Columbia shows the largest proportionate increase of any of the divisions of Canada, its increase of arcs being 377 or 82 per cent., and of incandescents 74,297, or 257 per cent. In 1898 British Columbia and Nova Scotia had almost the same number, British Columbia having 7 more arcs and 169 more incandescents; yet Nova Scotia has increased the number of its incandescents by 32,140, or 11.16 per cent. The three Maritime Provinces had in 1898, 951 arc lights and 46,977 incandescents, and in 1903 they had 1,267 arcs and 93,120 incandescents, an increase of thirty-three and one-third per cent. for arcs, and of over 98 per cent. for incandescents.

The imports of the country as well as the increased manufactured output of our own establishments attest the vigorous development of electricity as the harnessed servant of humanity. Of electric arc lights and carbon, and carbon points we imported during the past fourteen years an average of $35,000 worth a year, and the last two years' average was $76,200. Of electric light apparatus and batteries we imported in fourteen years an annual average of $407,000, and the last two years the average was $1,090,050. Of electric motors and meters in fourteen years we imported $151,700 a year. The average of the last two years is $378,300.

It appears to me that the outlook for Canada is one that shows the country going forward by leaps and bounds in its application of electricity. Electricity will drive the carriages on the King's highway as well as those on the iron way. It will do our ploughing, our sowing and our reaping. It will make trolley parks an important part of the national equipment for recreation. If it does not help us into this life, it will help some (no one of this Association of course) out of it—by order of justice. It will do the nation's smelting and welding. It will supply from peat bogs fuel for Ontario and Quebec. In the form of the "wireless" it will make travel by sea along our coasts and estuaries as safe as travel about the streets of our towns. It will make our hats, cook our dinners and warm our toes. It will become so tamed to our service that it will with the message present a photo of the speaker, and cut out in one town a cheque on a bank written hundreds of miles away, and do it so well that the original will be destroyed and the transmitted cheque remain the only existing original. We already have twelve messages over the one wire. How many more who can say? We have in use a telegraph-telephone system by which our railways can employ the same wire for both simultaneously. Our surgeons use it to minister to mind and body diseased. Our warriors use it in the form of the wireless to transmit orders from the right to the left of an army in extended order and thus are able to set thousands moving as one at the same instant over miles of distance.

In fact the electrical engineer is dealing with a force whose uses have become and promise to become even more in the future than in the past, so varied that more than any profession a man has to be a hustler all the time or he will become a way-back even while he is positive he is well to the front. The up-to-date man of to-day is rear-guard to-morrow if he is not always on the alert, so rapid are the movements, so numerous the applications of the electrical forces.

Department Agriculture, Ottawa, May 16th, 1904.

Countries.	Year.	Miles of line.	Miles of wire.	No. of messages.	No. of offices.	No of messages per head of population
Great Britain	1903	49,450	480,400	92,471,000	12,129	2.22
Australia.	1902	45,343	121,818	8,431,372	3,102	2.23
New Zealand	1902	7,749	22,672	4,713,351	1,103	6.10
India and other Asian Poss.*	1902	57,495	190,887	6,749,372	2,006	.02
African Possessions	1902	17,885	38,832	7,555,500		1.08
Canada	1903	36,780	96,728	5,313,800	3,004	
Newfoundland and B. W. Indies	1902	3,308	15,187	1,654,000	300	.92
Gibraltar and Malta.	1902	67		33,500		.15
Total British Empire.		218,077	966,524	126,921,895	21,644	
Abyssinia	1902	1,056	3,168	158,400		
Austria-Hungary	1902	39,372	198,303	31,554,715	9 228	.69
Argentina.	1902	29,397	58,656	7,000,000	520	1.46
Belgium	1902	4,047	21,874	14,252,100	1,372	2.07
Bolivia	1902	2,465	8,625	1,075,000	68	.47
Bosnia.	1902	1,803	4,873	427,452	134	.25
Brazil.	1900	14,710	27,720	1,505,042	1,003	.10
Chili.	1902	11,060	68,710	4,879,719	608	1.57
China.	1902	14,000	49,000	3 430,000	250	.01
Colombia	1898	8,600	25,800	600,000	448	.15
Congo Free State.	1902	888	3,108	62,160	40	
Costa Rica	1902	840	2,940	284,532	68	.92
Cuba.	1902	2,300	3,450	430,125	153	.27
Denmark	1902	2,385	8,855	2,409,365	169	.98
Ecuador.	1902	1,242	4,347	434,470	60	.31
France.		90,592	340,180	47,280,070	13,527	1.21
Colonies and Dependencies:						
Algeria.	1901	6,520	18,240	2,369,456	539	.50
Tunis.	1901	2,420	5,500	978,000	122	.51
Other Possessions.		10,700	32,100	1,605,000	300	.40
Germany.	1902	83,526	309,644	45,216,963	25,621	.80
Greece.	1901	3,830	5,590	1,205,095	241	.50
Guatamala.	1901	3,490	10,470	929,619	157	.59
Honduras.	1902	2,825	8,475	618,000	168	1.05
Italy.	1901	28,472	107,810	11,682,366	6,078	.36
Japan.	1903	x16,128	78,710	18,073,407	2,197	.38
Korea.	1902	2,170	6,510	325,500	325	.06
Luxemburg.	1902	656	1,390	87,300	196	.37
Mexico.	1901	43,675		2,665,998	377	.19
Montenegro.	1902	343	427	29,590	21	.13
Netherlands.	1903	4,010	16,158	5,728,222	761	1.08

Countries.	Year.	Miles of line.	Miles of wire.	No. of messages.	No. of offices.	No. of messages per head of population
Colonies, East Indies.	1901	7,518	22,554	729,316	389	.02
Nicaragua.	1901	2,440	7,320	140,640	119	.28
Paraguay.	1901	500	1,500	97,044	75	.15
Persia.	1901	5,480	8,270	16,540	112.00	2-10
Peru	1903	3,220		152,868	48	03
Portugal.	1902	5,301	11,688	4,054,230	461	.73
Portugal—Colonies of	1903	2,368	7,104	142,080	80	.01
Rumania.	1902	4,350	8,780	2,318,683	1,866	.12
Russia.	1902	106,417	325,978	*101,639,542		.15
Salvador.	1902	1,920	5,760	715,084	135	.71
Santi Domingo.	1902	430	1,290	40,000	65	.07
Servia.	1902	2,300	4,925	1,092,527	145	.44
Siam.	1902	2,900	7,700	154,000	360	.02
Spain.	1901	20,170	47,470	4,627,713	1,534	.25
Sweden.	1901	10,077	31,695	2,813,830	2,175	.55
Norway.	1902	9,978	53,813	2,278,639	974	1.01
Switzerland.	1902	5,556	23,765	3,273,784	2,137	.99
Turkey.	1902	25,100	39,800	4,976,070	907	.21
Egypt.	1903	2,562	10,868	x1,617,946	544	.16
United States.	1903	196,115	1,029,983	91,391,443	23,567	1.20
Hawaii.	1903	250	750	37,500	40	.24
Porto Rico.	1903	470	1,410	70,400	70	.07
Philippine Islands	1903	720	2,160	43,200	42	.00 1-2
Uruguay	1901	4,604	13,812	397,493	101	.04
Total Foreign Countries		854,268	3,099,028	430,118,178	100,697	
Grand Total.		1,072,345	4,065,552	557,040,073	122,341	

*Including Railway Telegrams numbering 91,639,542.

xNot including State Telegrams.

*The statistics for Africa are very incomplete, many thousands of miles of line being in ha[illegible] of companies not making returns.

xSubmarine cable 2,130 miles in addition.

MECHANICAL WOOD PULP.*

By Stanislas Gagne, B.A., Sc.

(Continued from last issue.)

Screening.

Where the pulp falls from the grinders enough water is added to it to render it fluid, and on its way to the reservoirs it passes over perforated plates which retain the chips and splinters that have passed through unground. It is again diluted here and is pumped up into the individual screens or into a long distributing trough above the screens. In Canada, only two types of screens are used, viz., the rotary or centrifugal and the vibrating, the former type being the newest and not so commonly used as the latter. Although they work differently, as will be seen later, their object is the same, viz., to separate the well ground from the badly ground pulp. Some mills separate their pulp into several classes, according to degree of fineness, but the majority make use of only one size of screen holes or slits, all the material not passing through these being entirely rejected; but it is a self-evident matter that it would be economical to use all the product of the grinders if a market could be found for it. We will confine our remarks to but one screen or separation, and describe some of the methods by which it is accomplished.

Vibrating Screens.

Figure 24 is a view of a vibrating screen. It consists of, first, a wooden box at the bottom of which are the screen plates; below these plates is a diaphragm which is made to vibrate up and down by means of a shoe and cam. The pulp held in suspension in water is admitted over these plates by pipe and tap from the long trough containing the stock, and a downward movement of the diaphragm draws or sucks the material through the slits in the plates; the next upward movement blows the slivers and other coarse material out of these slits; the two actions constituting a vibration. Figure 26 represents the diaphragm and connections. The box receiving the stock over the plates is usually made of wood and so hinged that it may be lifted over the rest of the machine. The frame containing the plates is also hinged and permits of being raised for examination and cleaning. The screen plates are made of brass about 12 by 40 inches in size, and 3/8 to 1-3-inch in thickness, with slits or holes 2 to 3 inches long and from .008 to .020 inch wide, according to the nature of the stock to be screened and the fineness of the product required. The connection of the diaphragm to the sides of the box is usually made by India rubber of suitable elasticity and strength. The knockers or shoes transmitting the vibrations from the cam are usually of wood and are protected by cast iron and bolted casings to prevent them from splitting. The cam is rigidly fixed to the shaft and is made of steel; it is so arranged as to give 1, 2, 3 or 4 throws each revolution, according to the speed of the shaft and to the rate desired by the manufacturer. These cams are so arranged on the shaft that the strain on the driving belt is uniform throughout each revolution. One or two springs are placed around or near the shoe so that it is always kept in contact with the cam, shock and noise being thus avoided. The capacity of such a screen containing 10 to 12 plates on four cams varies with the speed, the size of the slits and the quality of the stock. With No. 8 to 10 slits, ordinary well ground pulp and at a rate of 400 to 600 vibrations per minute, it is from two to three tons per day; and with No. 10 to 16 slits from [illegible] to six tons. The box over the plates is sometimes divided up, so that all desirable material passes through, the coarse being left over. This waste is put into a b[illegible] [illegible] and dumped [illegible] river or elsewhere [illegible] the location of the [illegible] The screens [illegible] as was seen [illegible] above the [illegible]

*The above paper won the first prize given by the publishers of the Canadian Engineer for the best student's paper presented to the Canad[illegible] of Civil Engineers for 190[illegible] [illegible] members of the Society.

row. Either this last method is adopted or a long second trough is added, into which all the screens discharge, and from which all the wet machines take their supply. This permits the cutting off of any screen for cleaning or repairs without stopping the wet machine connected with it. When the plates have been used for some time, and especially when

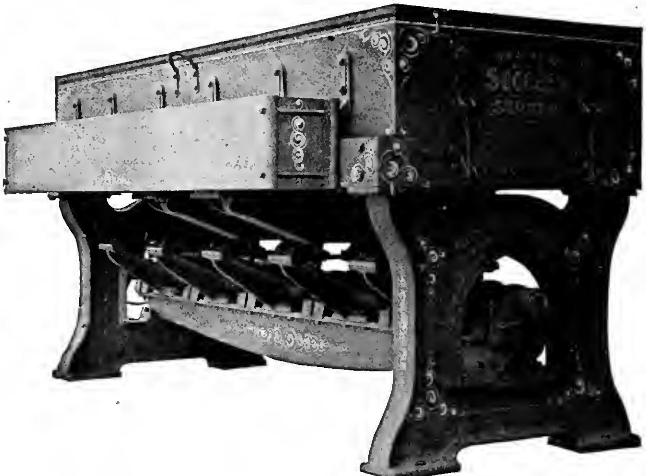


Fig. 24—New Success Pulp Screen.—Waterous Engine Works Co.

resinous balsam is used, they become clogged and must be cleaned. This is usually done with a jet of steam, or, if much gummed, with a piece of felt dipped in coal oil.

Centrifugal Screens.

Figure 28 is a cut of the Baker & Shevlin centrifugal screen, and Figure 35 illustrates the principle on which it works. As seen in this last figure, it consists of an outer

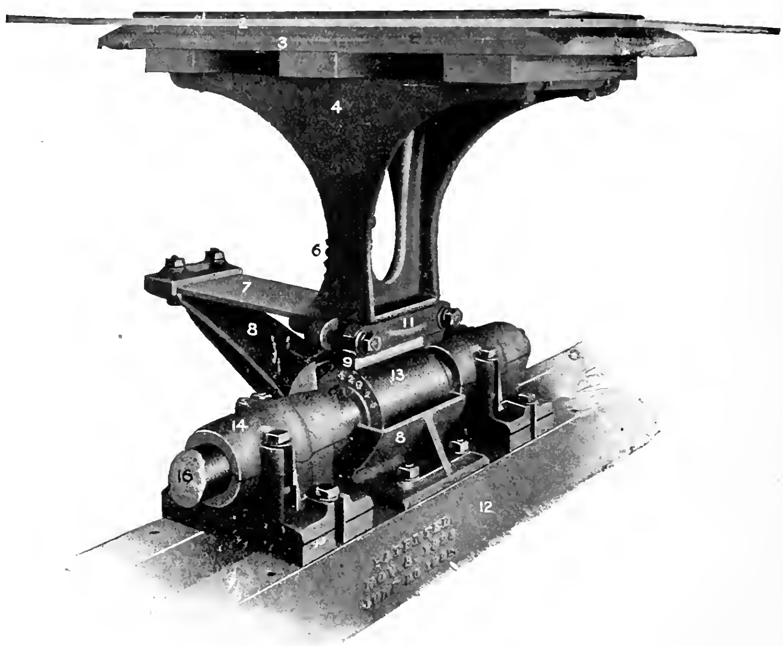


Fig. 26—Success Screen Diaphragm and Connections.

cylinder or casing A, of a cylindrical rolled brass plate B, perforated with small round holes, of vanes V, of a cylinder C, perforated at different plates with large holes, and of a tube and vertical shaft S on which the vanes are fastened. The pulp is admitted from pipe F, to which it has been pumped, and falls inside of cylinder C; the vanes, revolving at high speed, act as a centrifugal pump (thence its name), causing the pulp to flow radially; it then passes through the large holes in C, which serve to distribute it evenly and is forced against the screen cylinder B, where the desirable part i.e., that of a certain size and below it, passes through and falls in H, and the undesirable part, i.e., the coarse chips and splinters, remains inside and falls in K; the good pulp passes from H into the distributing trough above the wet machines, while the remainder passes from K into a wasting tank or a dumping place. The holes in B are round, and therefore quite different from those in the plates of the vibrating type, and, moreover, in this case the fibres must pass through them more or less end first. However, the screening action seems to depend, to a certain extent, on a coating as thick as the distance from the end of the vanes to the cylinder B will permit, which consists of coarse material collecting against the inside of the plate B, through which coating the pulp must

pass before reaching the holes in the plate. Therefore the screening action of this type is more obscure, i.e., not so well defined nor so easily conceived as in the case of the vibrating type, and hence can be judged by results only. Some claim that one of these centrifugal screens will do the work of as many as ten of the vibrating type, that it requires much less power and largely reduces the waste. On the contrary, others would not use them because, as they say, they injure the felting power of the pulp, which they render mealy or short by breaking the long fibres in roughly forcing them through a mass of chips and splinters. This is but one of the many differences of opinion between manufacturers in the pulp industry.

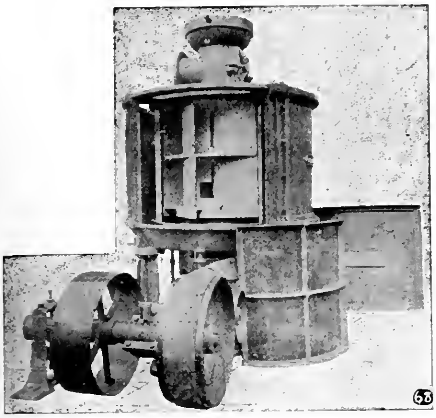
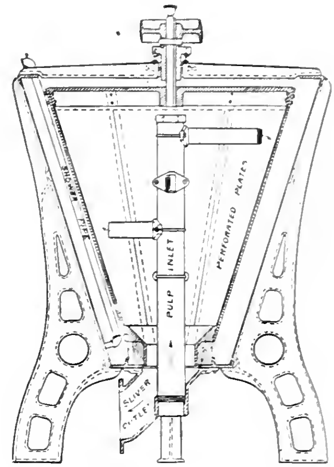


Fig. 28—Centrifugal Screen.

The Moore Rotary Screen.

This screen is gaining favor with many Canadian manufacturers and deserves mention here. Its appearance as shown by Figure 30 and Figure 31, represents a vertical section through it. The whole screen stands about 6½ ft. high and, with the exception of the wood step, which steadies the bottom end of the revolving plates and supports part of its weight, is made entirely of metal. The screen plates are of brass, made in sections, perforated with holes 85-1000 of an inch in diameter (smaller or larger at the option of the purchaser), and are secured to the steel frame by brass screws.

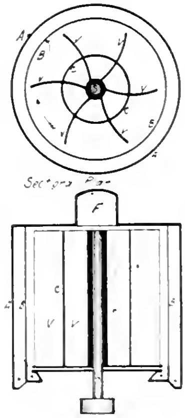
Fig. 30—Moore Rotary Screen of Jenckes Machine Co.



THE MOORE ROTARY SCREEN

Fig. 31—Section of Moore Rotary Screen.

The stock enters the screen at the bottom by means of a 6-in. pipe rising straight up at the centre of the screen, and is discharged against the screen plates by means of four or more smaller pipes which radiate from the centre pipe in different directions. Unlike the Baker & Shevlin screen, the screen plates, and not the centre pipes and vanes, revolve in this machine and usually at the rate of 60 to 70 R.P.M. This produces a centrifugal force, which, together with the force with which the stock is discharged through the radial pipes, carries the desirable pulp through the holes, while the coarser material remains inside and gradually falls down to the sliver outlet. The outside of the plates is kept constantly clean by means of a brass shower pipe; a larger capacity being then afforded. The screened stock comes out through the pipe, shown at the side in Figure 31, and the slivers by the elbow at the bottom. The plates are driven by a pulley on the top of the machine and are carried by a roller bearing of hardened tool steel which contains 14 one-inch steel balls. Like the Baker & Shevlin screen, the screening is done through round holes, and most of what has been said regarding it



Section Spreader
Fig. 35.

may apply to the Moore screen. The manufacturers claim an output of five tons of pulp per 24 hours with an expenditure of three horse-power. Most of the screens have a capacity of 20 to 25 tons per 24 hours..

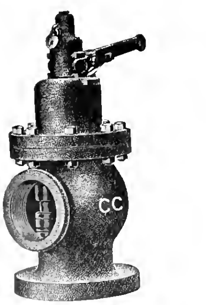
(To be continued.)

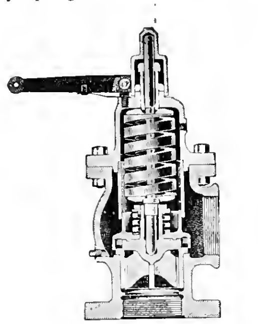
The original areas of the Cape Breton Coal, Iron and Railway Company at Cockran's Lake and vicinity have been increased from fifty-six to ninety-two square miles, and several seams have already been opened, showing a depth varying between four ft. six inches and nine ft. Every confidence is now felt in the ultimate success of the venture. It is proable that the new directorate of the company will be formed in August.

IMPROVED POP SAFETY VALVES.

The constantly increasing demand for Crane Patent Pop Safety Valves has made it necessary for the Crane Co., of Chicago, to increase the capacity of their manufacturing departments on these goods. They have also bought out a number of improved forms of pop valves for stationary, marine, locomotive and portable boilers; also a variety of cylinder reliefs, water reliefs, high pressure and hydraulic relief valves for all purposes and pressures.

The construction of these valves embodies a self-adjusting feature which automatically regulates the "Pop" of valve. In other words, maintains the least waste of steam between the opening and closing points, an improvement which will be readily appreciated, as there is no necessity of readjusting to regulate the "Pop" on changes in the set pressure. The valve is described by the manufacturers as follows: In all Pop Safety Valves, it is necessary to have a "Pop" or huddling chamber into which the steam expands when main valve opens, thereby creating an additional lifting force proportionate to this increased area and greater than the force of spring, thus holding the valve open until pressure is relieved. Means must also be provided to relieve this "Pop" chamber of pressure, in order to allow valve to close promptly and easily. This is accomplished by self-adjusting auxiliary valve and spring, entirely independent of the main valve and spring, and to further explain their operation, the steam in "Pop" chamber finds a passage through holes or ports into an annular space provided in the auxiliary valve or disc, and by reason of the light auxiliary spring, this pressure lifts





the auxiliary valve and allows the steam in "Pop" chamber to gradually escape, thus permitting a greater range in setting pressures with the least waste of steam, and at the same time supplying a cushion or balancing medium, thereby preventing any chattering or hammering and affording the easiest possible action in closing. This feature is embodied in no other make of valve, and unlike other Pop Valves, in changing set pressures within reasonable limits of the spring capacity, nothing further is to be done but simply turn down or out (for a higher or lower pressure), on the screw pressure plug at top of valve.

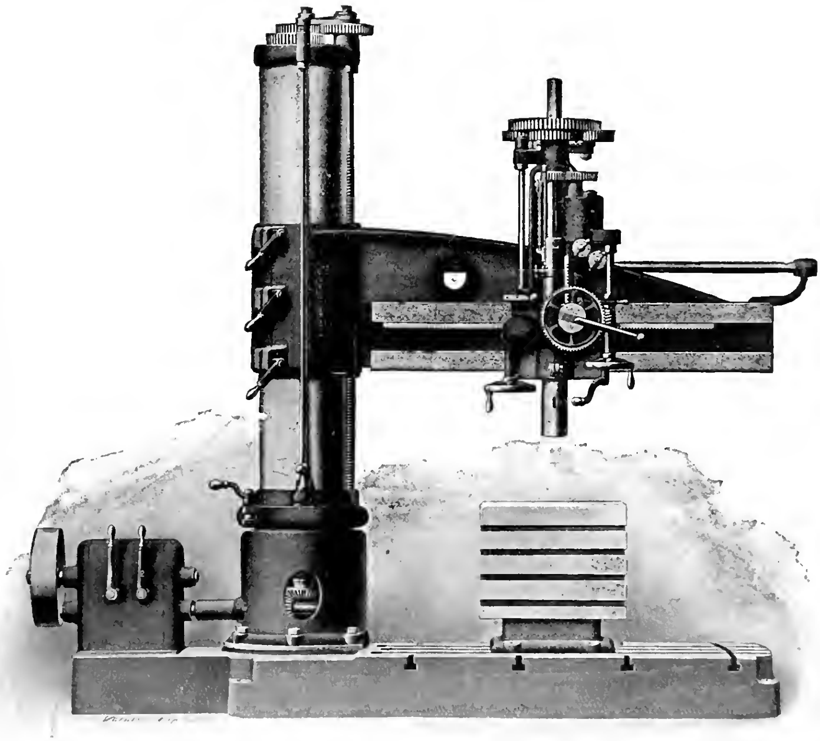
The encased spring valves are constructed with a casing or cylinder enclosing both springs, protecting them [illegible] steam, particularly high pressure, [illegible] velocity through all parts of valve before reaching the atmosphere, would otherwise have a tendency to disarrange the springs and other parts operating in connection therewith. This form of valve is also particularly useful, in fact, necessary where a number of valves may be connected to one main exhaust or discharge pipe. The encased spring chamber, extending over a greater portion of the top surface of main valve, prevents any retarding action of the steam due to back pressure, which might be caused by one or more valves opening slightly in advance of another, in having any material effect on the free opening of the other valves.

Their Composite Marine Pop Valves have been approved by the United States Board of Supervising Inspectors of Steam Vessels, and comply fully with all the rules and regulations governing the United States steamboat inspection service, some of the most important of which are here noted. They will be passed by all local inspectors on the basis of one square inch of valve area to three square feet of grate surface, and on water tube, coil or sectional boilers, carrying pressure exceeding 175 lbs., on the basis of one square inch of valve area to six square feet of grate service. They have bevel seats at an angle of 45 degrees from their centre line of axis. The seats are made of composition or with solid nickel bushing as may be required. The cam lever is capable of lifting the valve off its seat one-eighth the diameter of valve opening, whether or not there is pressure on the boiler. The cam lever may also be thrown over far enough to lock the valve open should the occasion require, or it is desired to blow off all or a portion of the steam from boiler through the safety valve. The cap is made with handles or cross-bars and fastened to the stem by a key pin. The stem in turn is securely attached to the main or wing valve and having a square section operating in a square socket or recess in the main valve, affords means of turning the valve on its seat, thereby removing any incrustation or saline matter that may accumulate. Self-adjusting "Pop" regulator, which automatically controls and maintains a minimum waste of steam between the opening and closing points, as more fully explained above. Encased springs made of the best steel and with self-adjusting spring discs. Valves can be taken apart without removal from boiler and without disturbing the outlet pipe. All parts have been carefully designed and strongly proportioned, and when fitted and adjusted with correspondingly strong springs, are suitable for pressures up to 250 pounds. Special valves for higher pressures are made to order.

IMPROVED PLAIN RADIAL DRILLS.

Radical changes have taken place, in the past few years, in the standard of construction of radial drills. In order to keep fully abreast of the changed conditions and greatly increased duties now confronting the radial drill, the American Tool Works Company of Cincinnati, have just redesigned throughout, their entire line of radial drills, taking into account every condition influencing modern radial drill work and every point which would tend to increase their efficiency. In the accompanying illustration is shown their new improved plain radial drill, which can be furnished with 4, 5, 6, and 7-foot arms. A feature of unusual excellence on this new drill is the feeding mechanism in the head, an entirely new and original construction. It provides eight distinct rates of feed to the spindle. These feeds are all obtained by the simple turning of a dial shown on the feed, box, until the desired feed, indexed thereon, comes opposite a fixed pointer. This method is an extremely simple one, as it requires no reference to index plates and subsequent handling of levers. The feeds operate through a friction, which permits a drill being crowded to its limit without strain to the feed works. A plate is provided, indicating twist drill sizes, from 1/2-inch to 3 1/2-inches inclusive, and their respective proper feeds, and this, in connection with the dial index, enables the operator to immediately secure the proper feed for the twist drill he is using. This involves no guess work, saves a great deal of time, and insures the

drill being used to its full capacity. Feeds can be automatically tripped at any position of spindle by adjustable trip dog and pointer, acting on the worm clutch. Depth graduations are on the spindle and all depths can be read from zero. Two or more dogs can be supplied, making it possible to counter-bore any number of holes without resetting. The trip acts automatically at full depth of spindle, preventing breakage of feed mechanism. Speed box is of geared friction type providing four changes of speed, each being instantly available by use of the two levers shown. Frictions are of patent double band type, employing very few parts in their construction, which can thus be made of such large proportions as to be free from slippage under the severest cuts, and obviating the use of loose delicate parts. A motor of any type may be readily attached at any time, connection being made through chain, gear or belt. The speed box can be easily interchanged with a cone by simply breaking a coupling connection on the lower driving shaft of the machine. Spindle has sixteen changes of speed, all immediately available without stopping the machine. This wide range of spindle speeds, combined with the exceptional driving power of the machine, renders the drill equally efficient with either ordinary or high speed twist drills. Column is of double tubular type. The outer column is practically integral with the inner column, which extends the entire height and has full bearing for outer column, at both top and bottom. This gives the equivalent of a double column, affording exceptional rigidity. Arm is of parabolic beam and tube section, giving the greatest resistance to bending and torsional strain. Its design leaves the lower line parallel with the base, and thus permits work being operated upon in close proximity to the column without the necessity [illegible] extreme reach of spindle. Arm is raised and [illegible] by a double thread coarse pitch screw [illegible] ings, and contr[illegible] gears are located [illegible] speed reduction [illegible] disengaged wit[illegible] operation. Spi[illegible]



New Improved Plain Radial Drill.

quick advance and return. Tapping mechanism is carried in the head, between the back gears and speed box, thus giving to the frictions, already very powerful, the benefit of the back gear ratio, making unusually heavy tapping operations possible, and also permitting taps to be backed out at an accelerated speed. The lever for starting, stopping or reversing the spindle is controlled at the head from the front of machine. Further particulars will be furnished by the makers.

RECIPROCATING VS. TURBINE ENGINES.

Editor Canadian Engineer:

Sir,—From a practical standpoint I am doubtful whether turbines will receive very much consideration at present, except for large installations, and in such cases the principal consideration, from the engineer's standpoint, is the question of space. So far as the relative merits of the steam turbine and ordinary reciprocating engine is concerned, a great deal may be said on both sides, but, as a matter of fact, we have not seen anything yet which would show conclusively that the turbine has any great advantage over the reciprocating engine. In fact, several serious disadvantages have been shown up.

First. The turbine requires, to give good economy, a high pressure of steam, a certain amount of superheating and a very complete vacuum. These are not always obtainable in the ordinary power plant, and it is difficult and expensive to maintain them in any plant.

Second. It is necessary [illegible] certain amount [illegible] the [illegible]

ance for a low temperature the blades will strike if a higher temperature is used, and if the clearance is made sufficient for the high temperature there will be leakage when the low temperature is used.

Third. The very high speeds necessary for the turbine is an objection, where direct current dynamos are used with commutators, causing wear and serious trouble.

Fourth. The turbine is not suitable where the load is very variable, as for elevator service or small tramway plants.

Fifth. The humming noise is objectionable in office buildings, hotels, etc.

In regard to the discussion that has appeared in the papers, a great deal has been said with regard to the steam turbine, because it is new and novel, and all the statements and nearly all the tests we have seen are made under theoretical conditions, showing the best results of the turbine, but none showing the results under ordinary conditions, whereas very little has been said by steam men in regard to the comparative methods of the reciprocating engines, and such tests as have been made are often under ordinary conditions, which would not be suitable for the steam turbine. From the engine standpoint we have seen two or three very good articles. One is "Steam Turbine Generating Plants," by Alfred Morkam, which appeared December 25th in the "Electrical Engineer," and is quoted in "Power," February, 1904. In this Mr. Morkam states that "the coal and works cost, taken from an average of all the steam turbine stations running at present, for steam turbines is .78 and .16 as compared with .738 and 1.4 for reciprocating engines, taken from 160 stations." He says that instead of the steam turbines being, as claimed, as good as the best reciprocating engines, the figures for the turbine stations are not even up to the average of the good and bad of all sorts. He shows up the difficulty of securing high vacuums, which add so much to the steam turbine economy, and that, although for more than twenty years the turbine has had the continuous attention of some of the best mechanical engineers, the difficulty in connection with clearance has not been solved, and is probably incapable of practical solution; second, that this clearance increases with use; third, to get results approaching the triple expansion engine, superheat of a considerable amount must be employed, and the clearance proportionately increased; fourth, stripping of blades may be caused by the superheat overheating or over-expanding them, or may also be brought about by water or any small foreign substance at the very high peripheral speed.

There is also a good article in "Power" for April by J. A. Seymour, of the MacKintosh & Seymour Company, showing that the average of several M. & S. engines under full load shows from 12.29 to 12.69 pounds of steam per electric horse power, as compared with 13.17 and 13.78 pounds for Westinghouse turbine, and at half load the engines show from 12.21 and 12.93 pounds electrical horse-power per hour as compared with 15.1 and 15.9 for the Westinghouse turbine. There is also in the same number an article by J. William Chubb on "Reciprocating Sets versus Turbo-Generators," in which he states that among engineers in Great Britain the relative advantages of steam turbines and reciprocating engines have been the matters most discussed in connection with power house plant, and it has been admitted that unless they are condensing and of sizes developing more than 200 h.p. steam turbines have no advantage over ordinary reciprocating engines. He gives a large number of tests, which show practically the same economy for each type.

My own opinion is that, although the turbines are being at present very much talked of and advertised, a little time will show up their weaknesses even more than at present, with the result that except in very large installations, where the conditions can be just right for the turbine, and where space is a chief requirement, they will not make very much headway.

Yours truly, R. E. C.

Ritchie, Hearn & Co., Ltd., of the Brantford Soap Works, have sold their present quarters and are now looking for a new location. They hope to remain in Brantford.

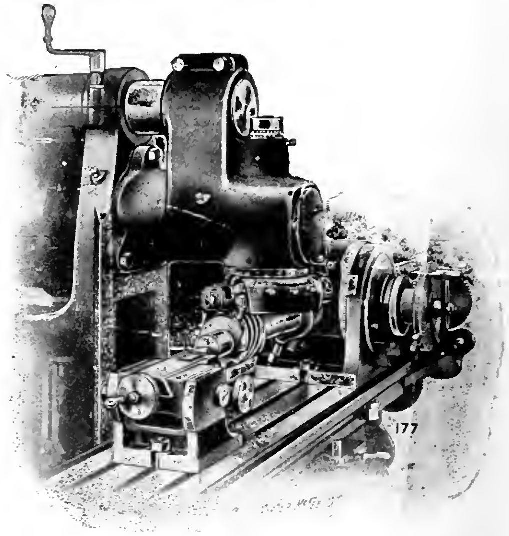
MACHINE SHOP NOTES FROM THE STATES.

By Chas. S. Gingrich, M.E.

VII.

Gas Engine Manufacture.

Nearly all gas engines employ in their valve mechanism at least one pair of helical, or as they are commonly called, "spiral" gears. The space which they occupy is usually limited, and the speed ratio between them is such as to require gears of an angle considerably greater than 45 degrees, and since the ordinary Universal Miller will not swing more than 45 degrees, it has always been quite a problem to rig up a suitable machine for cutting these gears. It was, therefore,



quite interesting to find a No. 3 Universal Cincinnati Miller performing this work with a brand new attachment, which is quite massive in its construction and strong enough to pull any cut within the power of the main belt of the machine. This particular job is shown in illustration herewith, and although the gear shown is of small diameter, the writer was shown steel gears of three pitch, approximately 10-in. diameter, which were milled with this outfit at a single cut and at a very good rate, leaving an entirely smooth tooth surface. This same machine was also employed for cutting the spur gears used on the same engine, and also for finishing a large number of the small parts which are usually done on a shaper.

This is another illustration of the activity that is going on among machine tools builders to immediately supply every demand for economical manufacture of special parts.

The Cincinnati Milling Machine Company will, without doubt, be very glad to give information in regard to milling spiral gears and similar gas engine parts, as I understand that they maintain a special department for supplying such information and making estimates on milling work.

ENQUIRIES FOR CANADIAN TRADE.

Further information regarding the following may be had on application to the High Commissioner for Canada, Victoria Street, London, S.W.:

A firm interested in the export of brass and copper tubes and electro-deposited copper shells desire to communicate with agents at different trade centres in Canada.

An importer of mica wishes to correspond with persons in Canada who are in a position to export this mineral in considerable quantities, and with actual owners of mica properties.

A firm manufacturing feed water heaters, winch condensers, fans and air heaters for drying purposes, and other apparatus of a similar character, desire to get into communication with buyers in Canada.

THE CANADIAN ENGINEER AT THE CANADIAN NATIONAL EXPOSITION.

The Canadian Engineer will have a Branch Office and Information Bureau in Machinery Hall, at the Canadian National Exposition, Toronto, August 29th to September 10th. Friends are cordially invited to make this stand their headquarters while in the city. Catalogues of advertisers, directories of the city and of exhibits, and other information of value to visitors may be secured from our Bureau of Information.

—At the annual meeting of the Canadian Electric Light Company, in Quebec, the following were elected to the board of directors: Rodolphe Audette, H. M. Price W. A. Marsh, Gasp. Lemoine, Chas. King, H. T. Machin, Jos. Paquet, Wm. Doyle, and R. Wilson-Smith, of Montreal.

THE "HARRIS-ANDERSON" PATENT FEED-WATER PURIFIER.

In modern power installations the importance of the complete removal of oil from the condensed steam that has to be used over again as feed-water is fully recognized by engineers who have any regard for the safe and economical working of their boilers, and efforts have for long been made, with varying success, to effect this much-desired re-

sult. Steam separators and mechanical filters, while they are a step in the right direction, have not of themselves been found to completely overcome the difficulty of extracting the finest particles of oil from the water. The "Harris-Anderson" Purifier, which is illustrated above, has successfully demonstrated that it affords a complete solution of the problem in a very simple and ingenious way, and working automatically it effects the removal of all oil, whether free or emulsified, and leaves the feed water brilliantly clear and in every way fit for boiler use. The removal of the free oil in feed-water can be more or less effected by many filtering devices: it is the extraction of the finely divided or emulsified particles, too small to be retained by any filtering medium, which has hitherto presented an insuperable difficulty. The difficulty has, however, been overcome at last by the "Harris-Anderson" system, which, speaking broadly, consists in the formation of a precipitate in the water, which envelops the particles of oil, rendering them capable of removal by filtration. The formation of this precipitate is effected by the addition to the water of minute quantities of two mutually interacting reagents, quite innocuous to the boiler plates or fittings. The reagents are supplied to the machine in a solid form, and in any convenient quantity, while the machine supplies them to the apparatus automatically. Thus, all need for weighing out, dissolving, and regulating the reagents on the part of an attendant, is dispensed with. The "Harris-Anderson" apparatus is now in constant use at a large number of power plants in Britain with excellent results obtained from an extended experience. Our illustration is taken from the installation now at work at the Electric Generating Station of the Cardiff Corporation, England, and is handling 10,000 gallons of feed per hour. John T. Webster, late Works Superintendent for the Bertram Engine Works Co., Ltd., Toronto, and formerly with the patentees of the "Harris-Anderson" system has lately returned from a trip to the Old Country as special representative for Canada for this apparatus.

IMPROVED PIPE DIE.

Threading pipes one inch and upwards by hand is perhaps as hard manual labor as a man can apply himself to. Tools that afford any relief from this exhausting labor are an undoubted boon to the workman, and effect a saving to his employer. The "Jardine" Patent Pipe Die, illustrated herewith, is an adjustable die, with adjustment to meet any variation in size of fittings. It is claimed that it works more easily and does better work than either the ordinary solid die or any of the well known opening dies. The reason of this superiority may be stated in a few words. The solid pipe

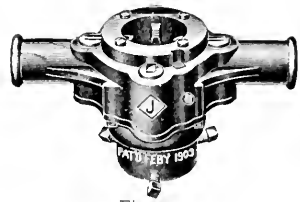


Fig. 1.

die works easily at the start of the cut, but much harder when near the finish, as the whole length of the cutter is required to taper the thread, the further the die goes on the pipe the harder it works.

The opening cutter type of pipe die, of which there are a number made in the United States, is adjustable to size, but works just like a solid die, that is, it cuts easily at the start and harder as the die advances on the pipe. In working the "Jardine" die it is adjusted so that the mouth of the die cuts

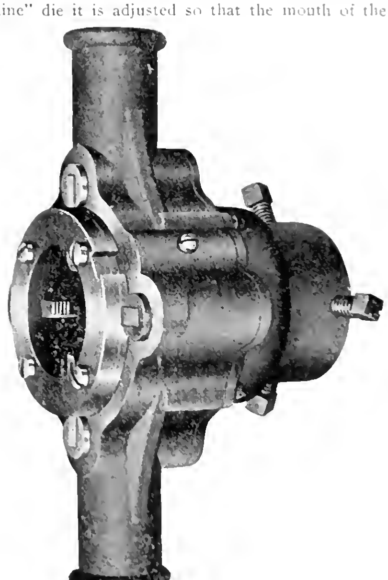


Fig. 2.

to the size of the point or smallest part of the thread. As the die advances on the pipe the cutters open out so as to taper the thread. The cutting is all done with the mouth of the die, and the further it goes on the pipe the easier it cuts, the die opening out as it advances, and the cut becoming lighter in consequence. The makers state that one man can

easily thread 2-in. pipe or two men 4-in. pipe at one cut. In testing the die, one man without assistance has repeatedly threaded a 4-in. pipe at one cut within five minutes. Fig. 1 shows the die in position to cut a thread. Fig. 2 shows the die in position to change the cutters. Fig. 3 is a section of the die in position to change the cutters.

A is the stock bored to admit the body B, and having the guide holes F for guide blocks E on cutters D. B, the body (carrying the cutters, or chasers D), is made to fit the stock A in which it slides freely up and down, but is prevented from turning by the key and key way shown in Figs. 1 and 2. A leading screw (Fig. 3) is cut on outside of body B, the same pitch as thread to be cut on pipe. C, the barrel, at lower end of which there are three set screws K by which it is fastened to the pipe to be cut. The upper part of the barrel has an annular groove, by means of which it is held in position in the stock A by the plate H. The stock A and the plate H revolve freely on barrel C. The inside of the barrel C is threaded to fit the leading screw on the body B, so that when the stock A carrying the body B revolves on the barrel C, the leading screw draws the body B into the barrel C. D, the four cutters or chasers are let into the guide

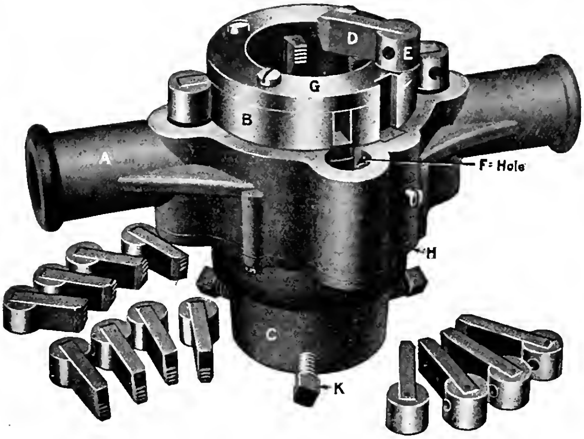


Fig. 3.

blocks E and held with a small screw. E, the cutter guide blocks in which the cutters D are fastened, slide freely in the guide holes F. F, the four guide holes in the stock A are bored at an angle to the axis of the stock, the angle being ⅜-in. to the foot, the standard tape for pipe thread (See Fig. 3.) G, a ring fastened by screws to the top of body B, to hold cutters D in place. H, a plate bored to fit barrel C, and fastened to bottom of stock A by screws, thus holding the barrel C in position. K, the screws to fasten the barrel C to the pipe to be cut. When the cutters are in place, the barrel C is revolved till the body B, carrying the chasers D, is brought to the position shown in Fig. 1. The die is then put on the pipe, the end of the pipe in contact with the mouth of the chasers, the three set screws K are tightened on the pipe and the die revolved to cut the pipe. As the die revolves, the leading screw draws the body B with the chasers D downwards; the chasers following the guide holes F recede radially from the pipe as they advance axially, giving the required taper to the thread. The die is made by A. B. Jardine & Co., Hespeler, Ont.

HEXAGON TURRET LATHES FOR BAR WORK.

The two lathes here described represent two sizes of a type of lathe which is extensively used in the leading workshops in England for the production of such articles as can be made from solid steel bars. They are made by Alfred Herbert, Ltd., of Coventry. They will deal with a very large ... is usually done upon engine ... output with conse- ... 10 or 20 per cent., but ... and instances ... by no means wanting in which an intelligent operator produces regularly more than four times the amount of work previously turned out by a man of equal skill upon an ordinary engine lathe. The lathes are designed to take full advantage of the recent improvements in steel for cutting tools, thus securing an extra source of economy. High-speed steel-cutters are furnished with every lathe, and the speed and feed tables are calculated on the assumption that high-speed tools only will be employed. The object of the designers has been to produce a standard machine with a standard set of tools suitable for doing any ordinary bar work without requiring an expensive outfit of tools and cutters, and special tools are only supplied where the work is of quite an unusual nature. The smaller of the two machines will deal with work made from bars up to 2 inches in diameter, 30 inches long, and the large machine has a range up to 4½ inches diameter, 42 inches long. Larger diameters of work can, of course, be dealt with when made from forgings, and longer pieces can be produced by doing the work at two operations, reversing it end for end. Another size of machine admits work up to 2½ inches diameter. For such work as piston rods, air pump rods, armature spindles, etc., in which there is a long, plain portion in the centre, with the ends reduced, very considerable savings can be effected with this lathe. Bright drawn bars are used, which are not machined on the plain central portion, but are subsequently finished with this part by grinding. One end is first machined, the work is then reversed, the part machined at the first operation being supported in a steady bush, fitted into the lathe spindle, and the second end finished. For repetition work having a number of diameters on the one piece special box tools are used, enabling all the diameters to be turned at the same time. Bolts, such as locomotive frame bolts, having taper shanks, are produced by a taper turning tool having an adjustable taper bar. The lathes are made either belt driven, as shown in the illustration, or with special motor-driven headstocks.

The No. 2 machine, which is illustrated by Fig. 2, has fifteen spindle speeds, five of which can be obtained at any time without shifting the belt upon the cone pulley. The chuck holds bars full diameter of the hole in the spindle, is opened and closed while the lathe is running, and has sufficient range to grip either bright bars or black bars having considerable variation in diameter and roundness. The chuck is operated by an ingenious arrangement of toggle levers, giving considerably more power with less effort to the workman than on chucks hitherto constructed. The bar is supported at the rear end of the spindle by a universal chuck operated by a hand wheel. The bed has flat sides, and the saddle bearing is of unusual length. The hexagon turret is of broad dimensions, and affords every facility for fixing the large tools, which are used on this type of lathe. The automatic feed to the saddle has three changes by means of a lever, and the automatic stops, which are used for disengaging the feed, are carried upon a hexagon bar along the front of the bed, this

so as to rotate with the turret. The gearing is contained in a casing which can be clearly seen in the illustration at the right-hand end of the bed. The advantage of this form of stop motion is that the stops are always in sight, and can easily be adjusted by the workman. The patent turning tools will take any required reduction at one cut, and have been designed to do away with some of the disadvantages of turret lathe tools as commonly made. Their construction can be seen by the illustration, and it will be seen that the cutter holder, which is made from a solid block of steel, can be adjusted with the same facility as a slide rest, being moved along its slide by a knurled knob shown at the top of the holder. The cutter is not an end-cutting, but a side-cutting tool, and moves in a straight line to or from the centre of the work, thus requiring no special adjustment for varying diameters. This is a feature not possessed by any swinging type of tool holder. The complete set of tools consists of three patent turning tools as above described, one cutting off and forming tool holder, one triple tool holder carrying an adjustable stop for the stock, an end rounding tool, and a centring tool, and a self-opening die head which has some novel features. The dies of this die head are produced by milling, and will cut clean threads

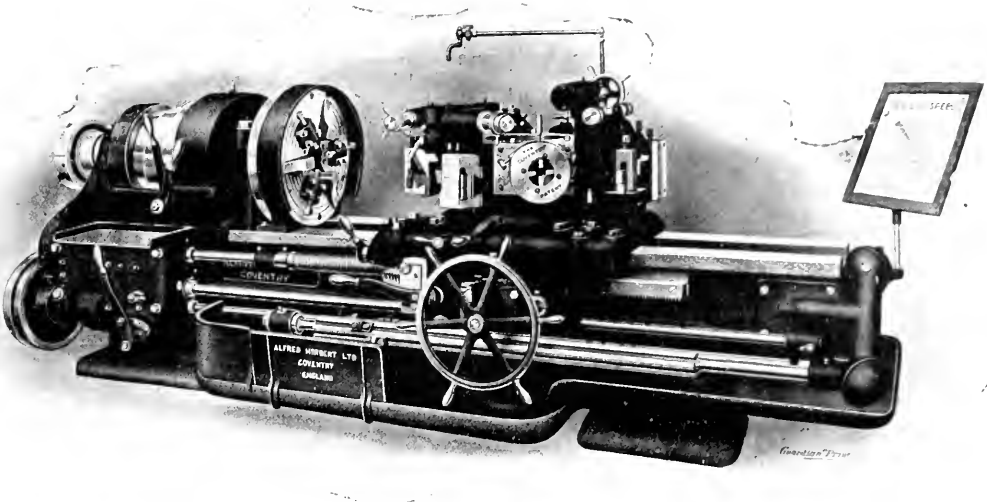


Fig. 2.

of accurate pitch. The special feature of the die head itself is that it is so designed that the stresses produced during the work do not tend to bell mouth the dies, as in the case with most other die heads. The dies bed right along their ends, and any pressure upon them, therefore, tends to bed them more and more firmly in position, and thus to produce parallel threads even on short threads. Another point on this die head which will be appreciated by users is that all the adjustments and changes which are required during the progress of the work, are made without the use of screwdrivers or spanners, suitable handles being provided for each adjustment.

The No. 5 machine, which is illustrated in Figure 5, is very similar in its leading features. It has, however, a number of variations, which are necessitated by its large size. Instead of the chuck used on the smaller lathe, an exceptionally heavy 3 jaw chuck is used, having screwed dogs in between the jaws for obtaining an extra grip upon the bars when doing the heavy work. It has been found in practice that no universal chucks made will stand against the heavy cuts which are frequently taken on big bars, but the chuck in question with the addition of the independent dogs, is found to be perfectly satisfactory. In use, the bar is centred by the jaws, and then firmly gripped by the dogs, which actually do most of the holding, after the bar is once set. The turret is heavy, and in order that it shall rotate easy an arrangement is provided by which it is raised up from its seat by the same lever as is used for

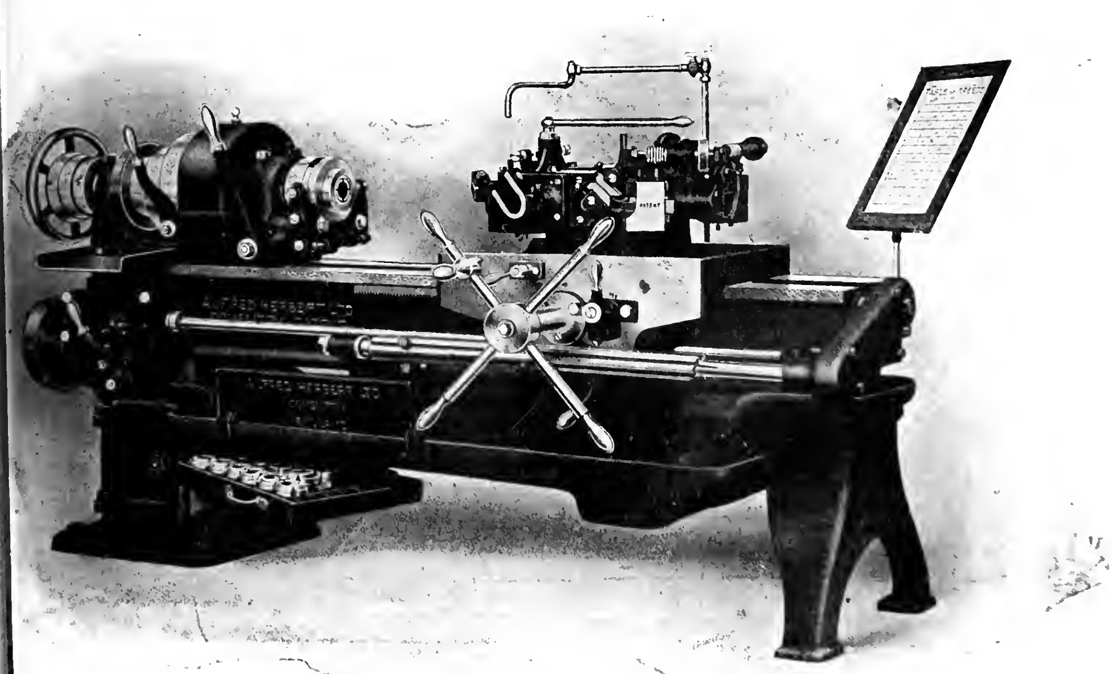


Fig. 5

unlocking it, and is then supported on ball bearings, thus enabling it to be moved round with the expenditure of very little power. The power motion operated by a horizontal lever at the front of the apron, moves the saddle quickly in either direction. The same kind of stop bar is used as in the case of the previous lathe. The saddle, however, has a chasing mechanism by means of a leader, which is used for screw cutting, and also for guiding the dies when a cut of cuts has to be taken on the same piece. The difficulty with a die head on such work, is to start the work at the correct point. The leader accomplishes this perfectly. The various motions, viz., the quick power motion, the feed motion, and the chasing gear, are all interlocked so it is impossible to have two motions in action at the same time. This lathe is a very highly specialized tool for the heavier kinds of bar work, and is being extensively used by English engineers. Two of these lathes, and one of the smaller lathes have recently been ordered for the new shops of the Canadian Pacific Railway, at Montreal, and will doubtless be objects of much interest to engineers in that district.

Alfred Herbert, Ltd., are represented in Canada by Peacock Bros., engineers, Canada Life Building, Montreal.

AN ADVANCE IN BIOGRAPH PICTURES.

The Westinghouse Companies in the United States and Europe have united in representation at the St. Louis Fair. A unique feature of their exhibit is the moving pictures, shown in their own auditorium on the grounds. These pictures are interesting, both in subject and in the manner in which they were secured. Most of the pictures are interior views in various Westinghouse factories, and show the activity prevailing in the shops, the methods used, and the general appearance of the shops, and they will, no doubt, be greatly appreciated by those unable to visit the shops. Some are outdoor scenes, one film, six minutes long, showing employees coming in procession from the Westinghouse Electric and Manufacturing Co.

The secret of success in obtaining moving pictures of interiors is ascribed to the light of the Cooper-Hewitt mercury vapor lamp. When the moving pictures of the Jeffries-Sharkey contest were taken at Coney Island the ring was cut down to twenty feet and 400 arc lamps were strung above it to obtain the requisite light. In several of the Westinghouse pictures the entire length of a quarter mile aisle is shown, and it is stated that at no time were more than sixty-four mercury vapor tubes used. As it is possible to carry the mercury lamps in front of the camera, their introduction marks an advance, in making possible the taking of interior shifting or panoramic views.

For several of the pictures the camera was placed about fifteen feet above the ground, suspended from a travelling crane, and moved slowly down along the aisle about fifty feet in rear of the lamps, which were also suspended from a crane. On the crane with the lamps was mounted a 500-volt motor connected to a 27-kilowatt generator of 125 volts, direct current. The sixty-four lamp tubes were hung in sets of eight, in eight frames, each about five feet high, three feet wide and four inches deep, and fitted with resistance coils, each board taking 35 amperes at 110 volts, the whole set requiring from 30 to 40 kilowatts, or about one-fifth the energy consumed by the 400 arc lights. The camera shutter was very fast, taking 15 pictures per second, and the light had to be the nearest possible approach to clear sunlight to make successful pictures.

It is said that the Westinghouse pictures, when all shown successively, occupy over two hours in presentation.

The Canadian Colored Cotton Company recently purchased the woolen mills of the Cornwall Mfg. Co., in Cornwall, and propose operating another cotton mill. On Aug. 6th, a vote is to be taken on a by-law granting exemption from taxes for ten years, and a fixed $50,000 assessment for school taxes. The company will erect a new plant, and employ 150 hands with a minimum pay roll of $50,000 a year.

INDUSTRIAL NOTES.

The Metal Shingle and Siding Company's factory at Preston was recently burned with a loss of $40,000.

The Belleville rolling mills, which have lain idle for some years, were started up on July 19th with a staff of seventy men.

The T. Eaton Company, of Toronto, will immediately commence work in Winnipeg on what will be one of the largest retail blocks in Canada.

Hawkesbury has granted twenty years' exemption from taxes and a $5,000 bonus to the W. P. MacNeil Company, of New Glasgow, if they erect a foundry and iron plant in the town.

Winnipeg is introducing a "nickel-in-slot" machine for selling water. Five tokens are sold for a cent, each token setting free three gallons of water when inserted in the meter.

The Niagara Falls Milling Company is the first company to erect a manufacturing plant by reason of Canadian development of Niagara power. The corner-stone of their mill was recently laid.

The Oshawa business of Frost & Wood is being removed to Smith's Falls. Three years ago, the Company bought out the large plant and business of Coulthard, Scott Company at Oshawa, and at that time thought to have had it all located in Smith's Falls within a year or so.

A new company to be known as the Northern Iron and Steel Company, Limited, has been organized with authorized capital of $2,500,000, and will take over the Cramp Steel Co., the affairs of which have for some time been at a standstill. The new company is formed of the common stock holders of the Cramp Co.

At Windsor, the township council recently granted the Canadian Typograph Company ten years' exemption from taxes, provided the company erects a factory, employs twenty men and pays the tax rate on the same amount worth of machinery now owned by the company. The company has been ordered to vacate the premises it now occupies, and has had several offers from other cities.

At a meeting of the directors of the Locomotive & Machine Co., of Montreal, it was announced that in addition to the amount paid for the plant at Longue Pointe, the directors have authorized the expenditure of $300,000, for the purchase and installation of new tools, equipment, etc., and the enlargement of the buildings. Albert J. Pitkin was elected president, to succeed the late Samuel R. Callaway.

J. A. Jamieson, engineer and contractor, of Montreal, is preparing plans for the new elevator for the Dominion Government, to be built at Port Colborne, the Lake Erie entrance to the Welland Canal. The building will be of two million bushels storage capacity, with large unloading and loading capacity, and will be of fire-proof construction throughout, and built on the new piers which were built by the Government inside Port Colborne Harbor.

The Imperial Steel & Wire Company, of Collingwood, at the first meeting of shareholders announced that the buildings were nearing completion, and would be finished by the time the plant arrived, which is expected to be all on hand early in August. The officers elected were: President, J. A. Currie; first vice-president, B. S. Wood; second vice-president, W. J. Lindsay; third vice-president, W. Saddington; secretary-treasurer, D. Donald.

The International Harvester Company is making an effort to secure a location in Brantford, for manufacturing ploughs. It is said, that the company is desirous of securing the new Cockshutt factory, which was erected last year. The buildings alone are worth $300,000. It is said the Harvester people have made an offer of $800,000 for the local plant and a large warehouse at Winnipeg. No acceptance has been announced. In the case of a sale, the American company will also acquire the plant of the Adams Wagon Works, adjacent to the Cockshutt factories, and engage in the manufacture of wagons for the Manitoba trade.

Work is now in progress on the new C.P.R. hotel and station in Winnipeg.

The Robb Engineering Co., Ltd., Amherst, N.S., will probably establish a new boiler-making plant.

A new immigration hall to cost $200,000 will be erected at Winnipeg, close to the new C. P. R. station.

Barnett and Record have a contract for the erection of a grain drying plant for the C.N.R. elevator system at Port Arthur.

It is said that Niagara Falls capitalists are proposing the erection of a machine and foundry works at Chippewa, Ont.

The contract for the new town hall in Athens has been let to Messrs. Dillon & Orr, for $3,900, the building to be completed by October 15th.

Robert Noble, of Norval, is about to erect a grain elevator at Acton. It will be fitted with modern machinery. A gasolene engine will furnish power.

A large lime kiln will be built by a Winnipeg company at Stonewall, Man., having secured the quarries from Fullmore and Higginbotham. Thirty-four cars of stone and lime will be shipped weekly.

Henry New, of Hamilton, has offered to build a $60,000 sewer pipe plant in St. Boniface, Man. He is purchasing seven acres of land, but has not yet come to terms with the council as to exemptions.

W. J. Devlin has organized a company with a capital of $20,000 to erect a foundry and machine shop in North Bay, if the town will give exemption from taxes and free water for a period of ten to twenty years.

Foley Brothers will build a chair factory, 50 x 70 feet, in Fort William. They will employ twenty-five skilled workmen at the start, and they expect the present venture will be the beginning of a very large industry.

It is reported that $50,000 will be expended on changing the Carmelite Monastery at Falls View, Ont., into a palatial and up-to-date hotel, under the management of Mr. Gilmore, of Toronto. The plans are as yet not completed.

An American syndicate is proposing to spend $800,000 in the erection of a beet sugar factory, in the neighborhood of Calgary. Gustavus Theden, of Minneapolis, is the representative of the syndicate who has been investigating the locality.

At a meeting of the directors of the Kemp Manufacturing and Metal Company, Limited, of Winnipeg, A. E. Kemp, M.P., was elected president; W. A. Kemp, vice-president; and John A. E. Wildman and William Crawford, managing directors.

The management of the B. C. Marine Railway Company has taken over the Albion Iron Works, Victoria, for a couple of months, in order to run off some very heavy castings for the Western Fuel Company, Nanaimo. The Albion Works are in the hands of the receiver, and negotiations are pending for a sale. If the deal is carried out, the works will be improved and put on a business basis.

A contract will be executed shortly, under which Armstrong & Company, the English gun and ammunition manufacturers will establish and operate at, or near Ottawa, a cartridge factory with a capacity of 20,000,000 rounds annually, when operated night and day. The company will establish a cordite factory in connection with the cartridge factory. Provision is made in the contract for the establishment of factories of similar capacity in Manitoba and British Columbia whenever required by the Department of Militia.

The annual meeting of the Hudson's Bay Company was held recently in London. A dividend of thirty-five shillings per share was declared. The fur sales showed somewhat unsatisfactory results, there being a general decline in prices, largely due to the Russo-Japan war. During the year the company sold 180,000 acres of farm land, against 308,000 last year, but the actual revenue from sales this year exceeded that of last year. During the period reviewed, 120,000 immigrants arrived, of which nearly 50,000 were from the United States.

The strike at the Dominion Iron and Steel Co.'s works at Sydney, N.S., is practically over. The force at work in the mills has been gradually increased, many of the strikers going back to work. The first steel since the inauguration of the strike was turned out on July 13th, and work in all departments is being resumed.

The Pittsburg Coal Co. is establishing a distributing point for its western trade at Fort William. Thirty-five acres have been secured on No. 2 Island, and a coal handling plant will be erected with storage room for a million tons. A bridge to the mainland will be built, with accommodation for railroad, traffic, and electric car line.

William Buckhoff has been appointed managing director of the Portland Rolling Mills Company, N.B., in place of R. C. Elkin, resigned. Since the reorganization of the Maritime Nail Works, there have been some changes in the company, which is almost identical with that owning the rolling mills, and these changes have further resulted in the reorganization of the rolling mills management.

The Grand Falls Power Company, represented by Barton E. Kingman, of New York, has paid into the New Brunswick provincial treasury $10,000 on account of the deposit required by the Government as evidence of the company's bona fides in the proposed development of water power at the falls. The establishment of works by the Electric Manganese Company at Grand Falls is to follow the water power development.

The Soo industries have been reorganized under the Lake Superior Corporation, and are resuming operations. Cornelius Shields is general manager. C. D. Warren, president, will have control of the policy of the company, which policy will be conservative, only those departments of the plant being opened which can be made to pay. Mr. Warren states that the company has on hand all the old contracts and some new ones, which will be sufficient to operate the plant for years. The Helen Mine is being operated, and all the vessels of the Algoma Central SS. Co. have been placed in commission.

The annual convention of the National Association of Master Plumbers and Steam Fitters was held recently in Toronto. About one hundred delegates from all parts of the Dominion were present. R. Ross, of Toronto, was elected president. The other officers are as follows: Vice-president, A. J. Hammond, Winnipeg; Secretary, J. G. Gordon, Toronto; treasurer, F. G. Johnson, Ottawa. Vice-president for Provinces: Ontario, Henry Mahoney, Toronto; Quebec, W. J. R. Hughes, Montreal; New Brunswick, William Watson, Moncton; Manitoba, J. Mould, Winnipeg; British Columbia, J. Coughlin, Victoria. Legislative committee, F. Bonhomme, Montreal, chairman; apprentice committee, J. Harrison, Toronto, chairman; sanitary committee, William Clarke, Hamilton, chairman. The convention decided to meet at Winnipeg next year.

The Backus syndicate, of Minneapolis, is about to develop water power on Rainy River, which will mean the expenditure of millions of dollars and the building up of three great manufacturing towns, Fort Frances and Rainy River in Ontario, and International Falls in Minnesota. E. W. Backus, one of the chief promoters, says: "The company, which is practically organized, will construct a dam which will cost over half a million, and put up a pulp mill of 325 tons daily capacity, with a paper mill of like amount, and a 3,000-barrel flour mill. A sawmill has just been completed at a cost of $350,000, and timber limits have been secured in Ontario and Minnesota at a cost of $1,000,000 that will last for twenty-five years. The plant will turn out over 70,000,000 feet of lumber a year. Forty million feet will be cut this summer."

The C.P.R. is reported to be making many improvements in its elevator system at Fort William. A new handling house is being built in connection with Elevator E; Elevator A is being remodelled and made faster, the Barnett & Record Co. holding the contract; the power at D is to be more than doubled, and a new cleaning elevator is to be built in place of the present one at Port Arthur, which is being sold to the C.N.R. The company's coal-handling plant

at Fort William, erected last year, is also said to be proving too small, and plans are on foot to extend the docks and greatly increase the capacity of the plant. Pressure is said to be felt especially in regard to hard coal storage, the present 108,000 ton capacity being already too small.

FIRES OF THE MONTH.

The railway depot at Nipissing Junction, near North Bay, has been totally destroyed by fire. It was a joint station, owned by the C.P.R. and G.T.R., and valued at about $3,000.

A disastrous fire, entailing a loss of nearly $75,000, broke out on July 8th in the big dry kiln of the Canadian Pacific Lumber Company at Port Moody, B.C. The entire plant on the north side of the track was burned, as were also two store sheds, the dry kiln and a steamer in course of construction, valued at $6,000.

The explosion of an oil furnace in the hammer shop of the G.T.R. shops at Point St. Charles resulted in a fire that did considerable damage. The spring shop, the blacksmith shop, and the hammer shop of the railway, the centre frame of the blacksmith shop, which is over 100 ft. in length, were completely destroyed. The damage is estimated at $10,000.

On July 15th the plant of the Metal Shingle and Siding Company, of Preston, was totally destroyed, involving a loss of in the neighborhood of $40,000, which loss is pretty well covered by insurance. The metal which covered the burning building confined the fire, otherwise some of the adjoining structures might also have been burned. C. Dolph, manager of the company, will at once build a temporary factory and resume business.

The carriage factory of C. A. Graham & Co., Napanee, was destroyed by fire on July 6th. The loss on the contents is about $5,000 and on the building about $2,000, covered by insurance.

The sash factory of Mason & Edge, Montreal, was damaged by fire on July 8th to the extent of about $10,000.

A boiler explosion demolished Peters & Cairns' sawmill, near Haliburton, killing two men. The plant, valued at $8,000, is a complete wreck.

Jas. B. Atchison's saw and planing mills at Cornwall were burned on June 24th. The loss is estimated at $40,000, with no insurance. The mill was thoroughly up to date, and employed about forty men. On August 6th the town will vote on a by-law authorizing a loan, without interest, to Mr. Atchison to rebuild the factory.

The new mill of the Ontario Corundrum Co., situated about twelve miles from Combermere, was destroyed by fire at a loss of $20,000. It will be rebuilt.

FIRE PREVENTION.

Following is an extract from a circular issued by the British Fire Prevention Committee:

"The increasing loss of life and property owing to children playing with matches and with fire has induced the Executive of the British Fire Prevention Committee to attempt a remedy by impressing upon children the dangers involved thereby, and the Executive consider that warnings embodied in fables or stories, which are read at an age when children's minds are very susceptible to such impressions—fables being generally remembered throughout life—would also act as a deterrent against carelessness with matches and fire for the coming generation. With a view of furthering this end, the British Fire Prevention Committee are enabled through a generous donation from a Canadian member to offer the committee's gold medal and a purse of £20 for the best fable for children calculated to serve as a warning against the danger of playing with matches or fire. The competition for this prize is open to British subjects resident in any part of His Majesty's dominions.

The conditions can be obtained at the committee's offices, 1 Waterloo Place, London, S.W., upon application by letter only, enclosing a stamped addressed envelope."

Mr. Chas. E. Goad, who is the donor of the prize, is a citizen of Toronto. He is a well-known civil engineer, and the founder of the series of insurance surveys which have been in use in Canada for the past thirty years. In 1886 the system was extended to London and the British Isles, and since then to the West Indies, Egypt and South Africa, and recently to Turkey and the East. He was born and educated in London, Eng., and is an Associate in Arts of Oxford University. Devoting himself to engineering, he was engaged on the Northern Railway, 1869-1870; on the construction of the Toronto, Grey and Bruce Railway, 1870-1873, and on the Montreal Northern Col. Railway, from Montreal to Ottawa (now a portion of the C.P.R. system), 1873-1875. In 1876 he was appointed chief engineer of the Halifax and Cape Breton Railway. In 1881 he was admitted a member of the Amer. Soc. C.E., and is a member of the Can. Soc. C.E. Mr. Goad is also a Fellow of the Royal Historical Society, and a Life Fellow of the Imperial Institute. On the organization of the British Fire Prevention Committee, in 1897, he was chosen as a member of the Executive. "Insurance Society," which is now published as the "Insurance and Financial Chronicle," was founded by Mr. Goad in 1881.

Mr. Goad is now on his way home to Toronto from Turkey and Palestine, where he has been engaged on surveys instituted by the Turkish Government.

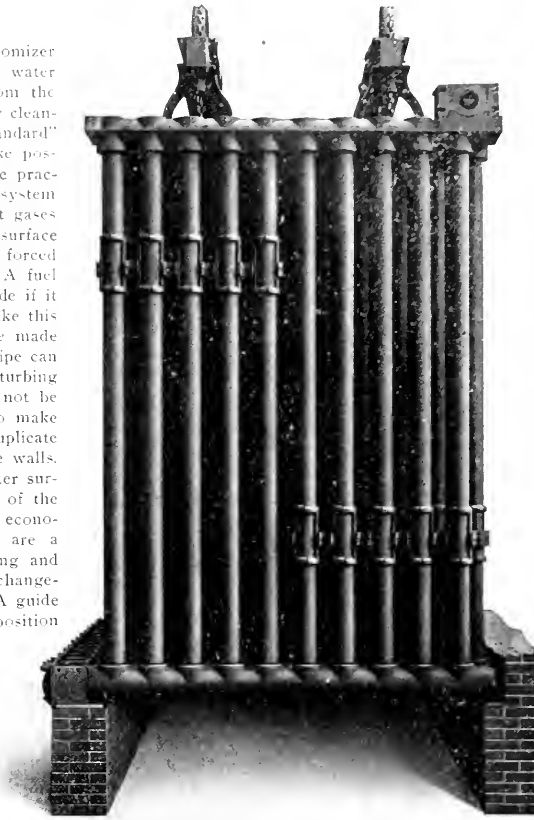
HOW TO MAKE HARD COPPER CASTINGS.

Pure copper, when it is melted and run in the moulds, is invariably porous or spongy. The reason for this phenomenon does not appear to be known, but the metal when in a molten state either absorbs or develops gases which cannot escape from the mass before it solidifies. For this reason copper castings, so called, are always alloys, although the introduced element is usually in a very small proportion. The following methods are recommended for small quantities: To every 25 lbs. of copper, heated to redness in a crucible, add 1½ lbs. potash or soda, 1 lb. alum, ¼ lb. of bone dust, and ¼ lb. of zinc or tin; melt, remove slag, cover with charcoal and run into ingots. This ensures a hard, dense, and tough metal. For small quantities, under 10 lbs., a graphite crucible with an asbestos cover should be used, and about 1-10th per cent. of pure sodium introduced into a cavity in a carbon rod and stirred into the metal, which is covered by a layer of common salt. Copper may be purified by stirring into it a mixture of 3 parts nitre and 2 parts argol. Phosphorus also is used to prevent porosity in copper. A reliable mixture for hammers, soldering-bits, etc., is copper, 100 lbs.; zinc, 1½ lbs.; stick phosphorus, 1½ inches.

The Quebec Steamship Co.'s new steamer Bermudian has been launched at Sunderland, Eng. The Bermudian is a twin screw steel steamer of 5,500 tons register, with speed of 16 knots. Her dimensions are: Length, 425 feet; beam, 50 feet; depth, 36 feet 6 in. She has accommodation for 240 saloon, 32 second-class and 48 third-class passengers. A large cold storage compartment is provided for carriage of green vegetables and meats. The steamer is to be delivered to the owners by November 1st, and will run in the Bermuda service.

—The Standard Tool Company, Cleveland, Ohio, are offering their bit stock drills and wood brace drills, sets 14-A and 13-B, containing drills, ⅛-inch to ⅜-inch by 32nds, in flat leatherette cases. These cases are very convenient to carry in the pocket. The drills fit in holes drilled for each size, which is plainly marked on the box, in gold, beneath the corresponding drill. These compact little cases will also be very useful in the tool chest as they take up but little room, and the drills can always be found clean and ready for use. Where economy in preserving drills is a consideration, these handy sets will appeal as well worth the cost, which is but a little over the price of the drills themselves.

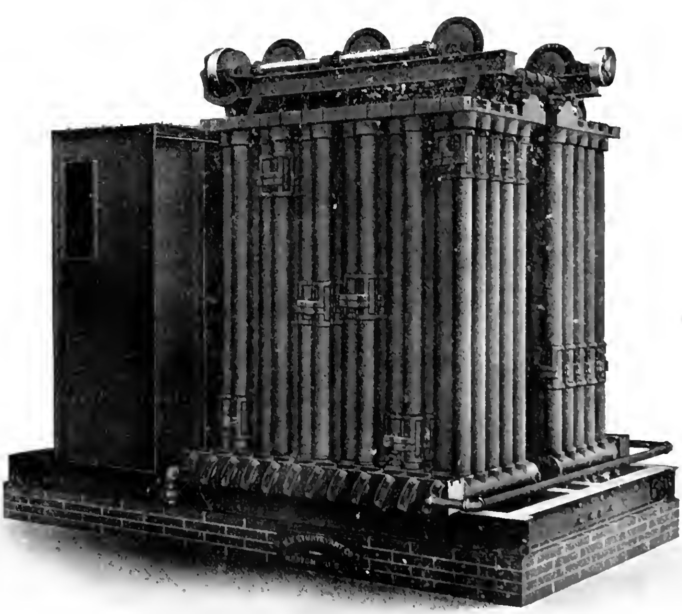
NEW FUEL ECONOMIZER.



The two most essential qualities of a fuel economizer are its ability to utilize most efficiently for heating water a maximum amount of heat (otherwise wasted) from the escaping gases, and the accessibility of all surfaces for cleaning, repairing and renewals. The Sturtevant "Standard" and "Pony" type economizers were designed to make possible these two requisites. These economizers utilize practically all the waste heat from the gases by a patent system of staggered pipes. This system compels all the hot gases to encircle the pipes, increasing the effective heating surface to a maximum. The gases are thus broken up and forced to give up their heat to the surrounding surfaces. A fuel economizer must be accessible both inside and outside if it is to be a valuable adjunct to a power plant. To make this possible the joints of the Sturtevant economizer are made taper metal to metal, and are so designed that any pipe can be taken out and a duplicate substituted without disturbing any other pipe, section or side walls. This would not be possible if packing, cement or rusting were used to make tight joints. Any header can be withdrawn and a duplicate replaced without disturbing any other section or side walls. There are no connection pipes to remove and all water surfaces are rendered accessible by the simple removal of the caps. The taper metal to metal joints make these economizers especially valuable for high pressures and are a marked improvement over gasket joints which spring and leak under such pressures. The scrapers are interchangeable and the driving mechanism positive in action. A guide plate for the scrapers is used to insure the scrapers position and prevents them from sticking and breaking. The driving pulley can be belted up parallel or perpendicular to the length of the economizer.

The Sturtevant economizers are not designed for forced circulation, but the connections are made in such a way that the flow of water is started in the right direction, and tends to keep the flow up and down the consecutive sections without making undue work for the pump. The foundations required for these economizers are comparatively simple. This is due to the fact that the machines are so constructed that the parts themselves contain the rigidity that would otherwise be required in the foundations. The fact that taper metal to metal joints are used also eliminates the necessity of building more rigid foundations, as there are no gaskets to loosen and leak if the foundations spring slightly.

Two general types of economizers are made by the B. F. Sturtevant Company, the "Standard" and "Pony". The "Standard" is built in sections containing pipes from four



to twelve wide, the staggered system of pipes making it possible to build sections of an odd as well as an even number of pipes. The "Standard Economizer" is adaptable to power plants of almost any size, but is more commonly used for boiler capacities of 350 horse power and over. The "Pony" type, as its name implies, is smaller than the "Standard" and is more adaptable to power plants of 350 horse power and less. All machines are made of the best cast iron for the purpose. All parts are tested to three hundred and fifty (350) pounds pressure before leaving the works and guaranteed to be sound and tight. All parts are machined to special gauges and kept in stock so that duplicates can be furnished without delay. The several installations of the Sturtevant economizers have proven highly efficient. Not only has it been proved that the gases are reduced to a remarkably low temperature with a comparatively small amount of heating surface, but the water has also been heated to an exceptionally high temperature. In

cases where the feed water contains foreign substances, the owners have found these machines to be especially valuable owing to their accessibility and ease of cleaning. An illustrated catalogue describing the Sturtevant "Standard" and "Pony" economizers is issued by the B. F. Sturtevant Co., Hyde Park, Mass., and is of interest to all steam users.

* * *

The Freeman, Hines Co., of London, manufacturers of [illegible] pipes, fitted with a patent double seal joint, are desirous of establishing a Canadian branch. The company has a capital stock of £50,000, and if a branch were established in Canada would have a paid-up capital of £75,000. They would employ from 80 to 90 hands. Parker & Bickford, [illegible] Toronto, are handling the Canadian interests of [illegible]

TOOL MAKERS' CALIPERS AND DIVIDERS.

A new line of calipers and dividers has recently been placed upon the market by the Brown & Sharpe Mfg. Co. of Providence, R.I. These show a radical departure from the well known lines of this class of tools, in that the legs are round and not flat, a feature that is readily appreciated, as this form adds materially to the stiffness and gives a neatness and finish that could not otherwise be obtained. This line new in design and intended to meet the demand for a tool adapted to the more delicate work required in tool making as well as to general use. Every care has been taken in proportioning the various parts to insure extreme rigidity combined with lightness and durability. The fulcrum stud is hardened, thus reducing the wear to a minimum and preventing the roughing up of the bearings. The spring is unusually stiff and of improved form with concave ends that fit into grooves milled in the ends of the legs. This construction insures rigidity, prevents side deflection of the legs and gives uniform pressure throughout the extreme movement. The legs are of steel, round, highly polished and every care is taken to have them uniform in finish. The measuring points come together evenly, a feature readily appreciated by every mechanic. The screw is of exceptionally fine pitch for accurate adjustment and is provided with a solid nut and hardened thrush washer.

* * *

RURAL TELEPHONES.

Nearly ten years ago the farming sections of Illinois and Indiana began fighting the Bell Telephone monopoly by installing co-operative lines. The plan has been quite successful, so much so that the Bell Company now offer rural telephones at very much reduced rates.

A plant of forty miles in Indiana, with good poles and wires and modern instruments, cost just what was received in dividends in three years, and a sinking fund is now being established. The cost of maintenance is said to be not five dollars a subscriber.

In building a rural telephone line, 25-foot poles, 5 inches at the top, should be placed 130 to 150 feet apart. Cedar poles are best, their life being 12 years. They should be well seasoned and peeled, and will last longer if cut in the fall. The tops of poles should be roofed. For cross-arm cut gain 7 inches from top, and 4¼ inches wide. If two cross-arms are to be put on, cut another gain 18 inches from top. Cross-arm should be bolted to pole with ½ x 7 lag bolts; two 20-inch iron braces should be bolted to cross-arm with 3½-inch carriage bolts, secured to pole with 3-inch lag screws. Pole should be set one-seventh of its length in the ground.

When wires are near heavy currents, such as car and light lines, use metallic circuit; that is, two wires for each line, and transpose the wires at every fourth pole. Never place wires within six feet of heavy currents. Solder all splices in the wire, and make tie wires about 9 inches long.

Secure telephone to wall, and run covered wire from telephone to outside wires, placing lightning fuse block near the 'phone, between line and 'phone.

The cost of one mile metallic circuit in Illinois is estimated as follows:

40 cedar poles, 25 feet, 80 cents each.....	$32 00
80 glass insulators......................	1 20
80 oak brackets.........................	1 00
160 spikes	50
2 miles No. 12 galvanized iron wire......	11 55
Digging forty holes, 15 cents each.......	6 00
Filling 40 holes, 15 cents each..........	6 00
Stringing two miles wire................	4 00
Peaking poles and nailing brackets......	1 50
	$63 75

(For part of the above information we are indebted to a neat circular issued by the Farr Telephone and Construction Supply Co., 118-120 W. Jackson Boulevard, Chicago.)

The Canadian Engineer

VOL. XI.—No. 9. TORONTO AND MONTREAL, SEPTEMBER, 1904. PRICE 10 CENTS / $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY, MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada, Great Britain and the United States, $1.00 per year, foreign, 6s. Advertising rates on application.

OFFICES—18 Court St. Toronto; and Fraser Building, Montreal.
Toronto Telephone, Main 4310. Montreal Telephone, Main 2589.
BIGGAR-SAMUEL, LIMITED, Publishers.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 15th of the preceding month or if proof is desired, 4 days earlier.

CONTENTS OF THIS NUMBER:

MUNICIPAL TELEPHONY IN GREAT BRITAIN.

By F. Dagger, Telephone Engineer, Toronto.

Notwithstanding the attacks of its opponents, municipal telephone systems in Great Britain are increasing in number, and so far the results have been most encouraging. At the present time municipal exchanges are in operation, or in course of construction, at Glasgow, Portsmouth, Brighton, Swansea, and Hull. The Glasgow system which first gave service in March, 1901, has now in operation 11,500 telephones, the average revenue per telephone being $21. In order, however, to compare this revenue with Canadian rates ten per cent. royalty paid to the British Post-Office must be deducted, which reduces the average receipts per telephone to $18.90 per annum. This exceedingly small charge to subscribers has enabled the municipality to meet all operating and maintenance expenses, leaving a balance sufficient to provide for interest and sinking fund, and to set aside a surplus of $17,775.50 for depreciation. This is an exceptionally good showing for two years and nine months' working, and furnishes undeniable proof that municipal telephony is anything but the failure alleged by its opponents. The undertaking which can pay its way as the Glasgow Corporation Telephone Department is doing, and can at the same time provide telephone users with a service covering 143 square miles at such a low annual cost, has no occasion to fear the assaults of its enemies, and can treat with contempt the opinions of experts on behalf of the companies who try to split hairs over the particular merits of different types of equipment, or find fault because the original estimates have been exceeded in order to provide a larger reserve capacity for increase of business.

Regarding the quality of the Glasgow municipal system the following statement by Frederick M. Adams in the Brooklyn "Eagle" should be sufficiently convincing:

"The Glasgow telephone service is the best I have ever inspected. Mr. Bennett informed me that statistics showed that the average time required to make a connection was less than fifteen seconds. I made a test on my own account, and called up ten subscribers. Of the nine who responded, the average time from unhooking the receiver to answers from those addressed was fourteen seconds. It should be explained that the telephone booth is practically unknown in the office of a Glasgow business man. The instrument is on the edge of his desk, and the receiver and transmitter are in one piece. This aluminum device is connected with a wire cord, and the customer may converse leaning back in his chair or walking about the room, as he prefers. It is a most decided improvement over the clumsy and antiquated system which yet prevails in most exchanges in the United States."

In speaking of the Glasgow rates Mr. Adams says: "Permit me to make a contrast. I live in a suburb of New York city, and it costs me forty cents to telephone to any part of the city, and fifty cents to get a connection with Brooklyn. Newark, New Jersey, is only twenty-five miles away, and the rate is seventy-five cents for a few minutes' conversation."

The following figures, taken from the report of the Corporation Telephone Department for the year ending May 31st last, make an interesting study, and it will be noted that the financial position of the undertaking is growing stronger each year, so much so that in a few years we may look forward to a reduction of the already low rates:

	1902	1903	1904
Capital expenditure	$938,415	$1,310,408	$1,520,208
Average cost per station (including spare plant and preliminary expenses	171 20	141 05	130 07
Amount borrowed and not repaid	902,800	1,181,130	1,300,330
Gross revenue	120,118	271,400	350,450

	1902.	1903.	1904
Rentals carried forward to following year..	60,471	100,882	117,708
Net revenue	68,047	170,518	241,742
Net revenue per station	12 53	18 67	20 95
Public telephone receipts	141 23	1,095 75	3,779 12
Working expenses	33,272	77,704	112,700
Interest paid	13,061	32,347	41,575
Sinking fund paid......	9,545	28,275	40,030
Depreciation fund	1,938	8,250	17,770
Loss on terminal fees remitted to subscribers	3,531	5,508	1,450
Royalty to Post Office..	6,716	10,582	24,384
Total expenditure	66,709	102,208	224,020
Total expenditure per station	12 18	17 79	19 63
	Per cent.	Per cent.	Per cent.
Percentage of Sinking Fund, plus Depreciation Fund, to total expenditure	3.93	4.2	4.67
Percentage of total expenditure to net revenue	91.17	95.10	92.06
Percentage of net revenue to capital expenditure	7.31	12.92	15.44
Percentage of outstanding rentals to gross rentals	13 95	9 91	7.44

The foregoing figures furnish details of the plant as originally estimated for, and that actually constructed from year to year; the figures in the last column representing the capital expenditure of $1,526,208.

	Original Estimate.	1901-2.	1902-3.	1903-4.
Completed stations	5,250	5,479	9,122	11,405
Partially completed lines	1,200	8,787	7,387	9,065
Switchboard capacity ..	6,050	7,060	10,826	12,062
Pairs of wire in cables..	6,450	14,572	18,171	21,874
Miles of pairs of wire in cables	4,938	11,061	14,029	17,597
Miles of trenching......	22	94	128	143
Ducts going out of exchange	32	126	135	150
Capacity of ducts in pairs of wires	6,900	27,000	31,000	36,000
Miles of duct	32	104	127	140
Miles of underground cable	31	114	162	206
Poles in ground	2,326	691	1,799	2,544
Iron standards on roofs.	456	228	243	239

It may be added that, with the exception of the new London post-office telephone system, the Glasgow municipal plant is the largest underground service in the United Kingdom.

Second in importance among municipal telephone systems is that of Portsmouth, which was opened in March, 1903. The results achieved with this exchange are interesting as proving how worthless are opinions of experts whose evidence is put forward by the monopolies for the purpose of preventing the establishment of municipal undertakings. At the Portsmouth local Government board enquiry two witnesses were put forward by the National Telephone Company to oppose the granting of borrowing powers to build the plant. These were J. E. Kingsbury, English manager for the Western Electric Company, of Chicago, a "Bell" corporation, and Herbert Laws Webb, late engineer to the New York Telephone Company (also "Bell"). The following are extracts from their evidence:

Q. In your view, will this business be a financial success?

A. (J. E. Kingsbury): No; I do not see how it can.

Q. Do you think it commercially sound?

A. I think it quite uncommercial.

Q. Are the (proposed) rates remunerative?

A. (H. L. Webb): I do not think that they can possibly be remunerative.

Q. Will the undertaking be a charge on the rates?

A. I think it will be a charge on the rates.

Notwithstanding these gloomy predictions Portsmouth comes out with a surplus such as they did not get on their electric lighting scheme until it had been working several years. The rates charged are, per annum: Unlimited service, $28.61; measured service, $17.05 and one cent per outgoing call; or $12.18 and two cents per outgoing call. The receipts for the year ending March 31st last averaged $17.54, or, with the post-office royalty deducted, $15.79 per telephone. The gross revenue was $29,137, and after paying operating and maintenance expenses, post-office royalty and Government long distance charges the net revenue amounted to $13,095, or equivalent to a dividend of over nine per cent. on the capital expended, $141,230. After paying interest and sinking fund a surplus of $6,136 remained, which has been set aside towards a depreciation fund.

The Swansea municipal exchange has been in operation since August, last year, and, as the report of the year's working is not yet out, it is not possible to give any definite figures, but the management have good reason to anticipate a satisfactory surplus. The rates are the same as at Portsmouth, and the latest available returns show 750 subscribers connected, while 205 additional orders were on the books. The original loan is exhausted, and additional borrowing powers are to be applied for to increase the capacity of the system to 1,500 lines. In connection with this the borough accountant recently prepared a report showing the cost of the present plant for 1,000 lines to be $98,861, or $98.86 per subscriber; the first year's revenue to average (including ten per cent. post-office royalty) $19.50 per telephone: the cost of operation and maintenance, royalties, interest and sinking fund, $18,316, leaving an estimated surplus of $1,184. As these figures were based on eight months' actual working, there is no reason to doubt their accuracy.

The Brighton municipal exchange was opened in November last, so there are not yet any accounts available. The rate for unlimited service is $26.80 per annum: the number of subscribers, 800. The whole of the plant in the town is underground, poles being used only for country services. There has been considerable controversy in regard to the respective merits of the competing services in Brighton. The National Telephone Company has recently installed the latest "central energy" system now in use in the large "Bell" exchanges in the United States and Canada, and the company's officials have frequently asserted that the municipal service was "inferior and

inefficient." As a result of this, A. R. Bennett, the engineer of the municipal system, issued enquiry cards on the subject to all subscribers having the telephones of both systems, and the following is a summary of the replies received:

In favor of municipal service..........	398
In favor of "company's" service.......	5
No difference	12
Satisfied with municipal, but expressed no opinion about company........	28
Uncertain	4
Total	447

Eighty-four of the 398 emphasized their verdict by such remarks as "By far," "Most decidedly," "They cannot be compared," "Municipal the only efficient and trustworthy one," "Most emphatically," "Without hesitation," "By a very long way," "Unquestionably," "Without doubt," "Absolutely the very best," etc.

The Hull municipal exchange will be in operation very shortly. The rates are: Unlimited service, $30.68 per annum; second and subsequent connections of the same firm, $28; measured service, $14.61 and two cents per outgoing call. There are over one thousand subscribers, and additional contracts are coming in rapidly. Practically the whole of the members of two of the principal industries of the port have signed municipal telephone contracts.

Municipal telephony in Great Britain has evidently come to stay, and the results up to date will make it exceedingly difficult for its opponents to produce arguments sufficiently convincing to stem the tide in its favor.

—A special correspondent of the Canadian Engineer writes of a trip to Winnipeg, and is enthusiastic as to the prospects of the Canadian West. Winnipeg will probably be more to the trade of the Canadian West than Chicago has been to the trade of the American West, and if the evolution of the Canadian Chicago is unfolded on analogous lines, the industrial history of Winnipeg should now begin to develop. The commercial expansion of Winnipeg in common with most towns of Manitoba and the North-West is proceeding with great rapidity, and if manufacturers of eastern Canada wish to acquire and hold their due share of this trade they should get into closer touch with the West than some of them seem to do. A great deal of business that might be done with eastern Canadian firms is being grasped by manufacturers in the mid-western States. The industrial east should be linked with the commercial west, and if this is not accomplished it is because many firms in the older Provinces are not aware of what is transpiring in the great western plains of their own country. Every manufacturer of Ontario and the Provinces to the east who aims at doing a trade beyond the confines of his own Province should take a trip to the West and see for himself how substantial is the progress that has been made there in the last ten years.

—It is satisfactory to learn from South African Mines, the leading mining and industrial journal of South Africa, that the experiment of introducing Chinese labor into the Transvaal mines promises to be a practical success. The mine managers have closely watched the work of the first instalment of Chinese laborers, and reports coming to the President of the Chamber of Mines enable him to state that the raw Chinaman is a distinct improvement upon the raw Kaffir. By the end of September there will be 11,000 imported laborers in the mines of Johannesburg, and our contemporary confirms the predictions of the mining authorities that the Transvaal is again on the high road to prosperity. An assurance of this may be taken from the fact that the output of the gold, diamond, coal and silver mines of the colony for the first half of 1904 makes a total of £8,072,027 sterling, while the net profits in the same period are estimated at two and three-quarter million pounds sterling. This is encouraging news after the poor trade reports of the past year, and, as there is a large prospective market for Canadian machinery and manufactured goods in South Africa, exporters from this market will do well to give attention to these colonies. Our contemporary is of opinion that, other things being equal, a preference will be given to Canadian goods over foreign goods, but even without this friendly sentiment and the actual advantage now given to Canada under the South African preferential tariff there is a great future for Canadian products in that quarter of the world.

—In another part of this issue will be found the results of an investigation by a representative of this journal into the progress of acetylene gas lighting in Canada, instancing more particularly the case of North Bay, Ont. There appears to have been more progress in the wide-awake west than in eastern Canada in this field of enterprise. There is a prevailing opinion among those interested as operators of lighting plants that many more towns would be using acetylene if the price of calcium carbide were reduced. Theoretically, a pound of pure carbide makes five feet of gas, but in practice only about four feet is got from the average quality furnished, and adding freight to the cost of carbide the price will average $72 to $75 a ton. This makes the cost rather high to offer a very attractive field for investment in those towns in which acetylene would have to meet an established rival like coal gas or electricity. In a growing young village or town where no other public lighting has been introduced the advantages of acetylene over coal-gas or water-gas in several respects appear to be pretty clearly shown in our report. For cooking purposes coal-gas is cheaper, though strong claims are made for one or two new types of acetylene gas stoves now being put on the market. If these claims can be proved in practice, then the day is not far distant when acetylene will largely supersede coal-gas for lighting, and be a competitor also in cooking, provided that the price of carbide is reduced. In this development there will still be a keen competition between the two gases, for it will be admitted, in view of the value of the by-

products of a coal or water-gas plant that those establishments could still stand a considerable cut in the profits on the gas department of their output. Evidence of these possibilities is furnished in the case of Australia, whose imports of carbide this year are expected to be over 1,100 tons, according to the Canadian commercial agent there, owing to the fact that the German carbide combine has been broken. German carbide is selling on that market lower than has ever been known, and it is said that some of it is now coming into Canada in spite of the surtax on German goods. The acetylene light, it may be added, has had its difficulties to overcome apart from the high cost of carbide. Accidents have happened, because most of the experimental lighting done throughout Canada, as well as in other countries, in the past few years, is by isolated plants, whereas practically no coal-gas lighting is done except on a large scale and for public lighting, in which case, unlike the isolated acetylene plant, there is always some one whose sole work is to run the plant and guard against accidents. We can imagine what would happen if the coal-gas business was carried on by the same number of isolated plants, left to casual attendance, or in some cases to run themselves, as is the case with private acetylene generators. But the record of town lighting plants of the acetylene class already compares favorably with coal-gas ones, both in Canada and in Europe, and time will improve this record. Considerable progress has been made in Canada in train lighting by acetylene gas. This gas was introduced several years ago on the Canada Atlantic, and the Canadian Pacific Railway Co. is adopting it extensively on its system, as is also the Canadian Northern. Over sixty trains, comprising about 360 cars, on the C.P.R. are now regularly lighted by acetylene, and the light is as satisfactory to the train hands as it is to the patrons of the railway. Another successful field for acetylene is in the lighting of buoys along our rivers and lakes. The lighting of the St. Lawrence buoys during the past year by this gas has been found most satisfactory, and navigators state that the light penetrates a greater distance, especially in misty weather, than any other light yet used. In consequence of this favorable report a factory has been established by the Dominion Government at Prescott for the manufacture of acetylene gas buoys for the whole system of inland and sea coast navigation.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

The 1904 convention of this body was held in Hamilton, Ont., on August 16th and 17th, in the council chamber of the Hamilton Court House.

President H. E. Terry replied to an address of welcome by Mayor Morden, who was introduced to the Association by ex-Ald. R. J. Pettigrew, of Hamilton No. 2. The Association was then welcomed by Hamilton, No. 2, by their president, J. Ironside.

The following delegates and executive officers answered the roll call: H. E. Terry, president; J. M. Dixon, treasurer; W. Inglis, secretary, all of Toronto; J. Ogle, Brantford, conductor; F. Scultherpe, Hamilton, door-keeper; delegates, Toronto, No. 1, A. M. Wickens, G. C. Mooring, W. McGhie, W. Oelschlager. Brantford, No. 4, J. Ogle. Berlin, No. 9, W. Oelschlager. Chatham, No. 21, E. Grandbois. Dresden, No. 8, W. Steeper. Waterloo, No. 17, N. Beam. Hamilton, No. 2, W. F. Crockett, W. A. Sweet. Vancouver, Brockville, and St. John, N.B., delegates did not attend, and vice-president, John Uttley, was also absent.

After the reading of the minutes of the last meeting, the president's address, secretary's report, and the treasurer's statement were read.

The president's address, after welcoming new members, proceeded as follows:

Clause 1.—Early this year it was found that Toronto No. 18 were having great difficulty in getting out their members to the meetings, and that there was great danger of them becoming defunct. After several meetings with the brothers, it was decided to effect an amalgamation with Toronto No. 1, and on March 8th, No. 18 surrendered its charter, and the members were accepted in Toronto No. 1, and in view of the fact that No. 1 assumed the risks of No. 18, the cash in possession of No. 18 was turned over to No. 1.

I am pleased to report that on May 16th an Association was instituted in Chatham to be known as Chatham No. 21, with a charter of twenty-one members. Also on July 26th an Association was instituted in St. John, New Brunswick, to be known as St. John No. 22, with a charter list of 43 members. Both of these Associations are reported as doing well, and are in a fair way to become useful additions to our order.

I am pleased to report that Ottawa Association will be in working order again before the end of the year.

Clause 2.—I would recommend that you take into consideration the matter of reducing the per capita tax of the Associations that are too far distant to be represented at this convention. Also that those Associations who do not pay sufficient tax to cover their representative's expenses, should pay one-half of his expenses.

Clause 3.—I would also recommend the advisability of meeting every two years instead of annually.

During the year the secretary's correspondence and enquiries regarding the Association have been very large, the small amount of advertising done in the Canadian Engineer and the Electrical News having brought forth fruit abundantly.

The secretary's report submitted subjects for consideration, as follows: The correspondence during the past year has been very large. The advertisement in the Canadian Engineer and the Electrical News has brought our order more prominently before the public and engineers all over the Dominion, and I would recommend that the work be continued.

Clause 1.—I would ask you to consider the numerous enquiries about the forming of new branches. I am of the opinion that if some system were put into use we would have no trouble in organizing branches all over the Dominion and making this order what it should be—the leading society of engineers in the Dominion. A great many ask for examination papers and certificates of competency. This we, of course, have not got in our order, but I would strongly recommend that a board of examiners be appointed by this convention, said board to have power to examine all members of the C.A.S.E. and grant them certificates of competency, according to their qualifications.

Clause 2.—Another matter which should be taken into consideration is the establishing of a sick benefit, controlled by the executive. This could be done quite satisfactorily by paying a limited number of weeks per year and by grading the membership according to age or by paying a flat rate per year.

Clause 3.—The financial standing of your executive should receive your attention. We should either raise our per capita tax or pay less mileage and per diem. I would recommend that the per capita tax be raised to $1 per year.

Clause 4.—I would also recommend that a representative be appointed in each province in the Dominion, said representative to receive applications for membership and do the business of the order in his province.

Clause 5.—I am pleased to say our membership has increased during the year; number of members last report,

258; admitted by initiation and new branches, 58. During the year twenty-two members were suspended—many of whom will return—leaving our present membership 294. If every member would press the work he could secure many applications.

Clause 6.—The receipts and expenditure for the year are as follows: Receipts from all sources during the year, $190.50; expenditure during the year, $68.10; leaving a balance of $122.40. This, you will see, will need to be carefully dealt with to leave the executive some funds to start the year's work with.

On motion of G. C. Mooring, seconded by W. F. Crockett, these reports were given a special committee for distribution to the various standing commtitees.

The following standing committees were appointed:

Mileage—N. Beam, W. Steeper.

Ways and Means—R. J. Pettigrew, E. Grandbois, W. Outhwaite, W. A. Sweet, W. McGhie.

Good of the Order—G. C. Mooring, W. F. Crockett, A. M. Wickens, J. M. Dixon, W. Steeper.

Auditors—W. A. Sweet, J. Ogle.

The following notices of motion were given:

G. C. Mooring: "That the word steam be substituted for the word stationary, making the name of the Association in future, The Canadian Association of Steam Engineers."

J. M. Dixon: "That the preamble of the Constitution be amended, to read in a manner which would appeal more strongly to the mind of the enquiring workman."

The special committee on distribution reported as follows: "That the secretary's report had been dealt with as follows: Clauses 1, 2, 4, 5, and 6, were referred to the Committee on the Good of the Order, and clause 3 to the Committee on Ways and Means. The special committee was then discharged.

After introducing to the Association the delegate from Chatham, the meeting adjourned until 2.30 p.m.

At the afternoon session, the Committee on Ways and Means report on the president's address was received, and productive of much discussion, but it was finally adopted as read.

The report of the auditors was also received and adopted.

The Mileage Committee presented their statement and same was accepted.

F. B. Uttley, of the Goldie & McCulloch Co., Limited, was invited to address the convention, and in a happy manner he illustrated the difference between the old-time engineer and the present product now supplied to the manufacturers in Canada, through the instrumentality of such organizations as the C.A.S.E. He offered, on behalf of his firm, hearty co-operation in their efforts to educate and raise the standard of the Association's membership by supplying them with information through correspondence or by a visit to their works in Galt, Ont.

The Association thanked Mr. Uttley for his promise, and adjourned to visit the sub-station on Victoria Ave., of the Hamilton Cataract Light, Power and Traction Co., Limited, where W. A. Sweet escorted them through.

The International Harvester Co.'s works were also visited, where, in the absence of George L. Rice, Messrs. James A. Publow and W. R. Dunn took the party in charge.

A special car was placed at the disposal of the Association by the Hamilton Street Railway Co. during the afternoon and evening, a courtesy which was greatly appreciated.

In the evening, the visitors and their friends were entertained at Cotter's Hotel, on Hamilton Mountain, by the local Association, and an excellent programme was carried out and refreshments supplied.

Robert Baker, engineer, of 101 Wilson St., Hamilton, read a paper describing his Patent Perfect Combustion Automatic Machine. There have been many devices patented and placed upon the market, says Mr. Baker, but not one of them will separate the impurities from the pure gases, and none will work without artificial draught.

The appliance described works automatically, and is fed from the rear end of the boiler. The coal is conveyed forward into the generator thence to the cooking chamber,

President, F. J. Sculthorpe.

Vice-President, W. A. Sweet.

Secretary, W. Inglis.

which is formed into the bridge wall, where the coking takes place, and the gases and smoke are given off and conveyed rearwards by means of a fan. In their travel rearward, the impurities are deposited into receivers in liquid form. This property is a by-product, such as is given off in gas factories. The pure gases are conveyed forward at one-half pound pressure and fed into the bed of burning coke and at the same time fresh air is being supplied to the fire through arches provided for that purpose through the bridge wall and under the grates, which allows the chimney to perform its proper functions. The arches through bridge wall for supplying air extend to the rear end of the boiler.

The object of the invention is, first, to provide an apparatus adapted to extract and burn gas and smoke from soft coal; second, to provide means whereby gas and smoke from soft coal may be utilized and generated into heat for heating purposes; and third, to afford facilities whereby the apparatus may be adapted to perform its functions in connection with boilers, furnaces, stoves, and other heat generating apparatus. A blue print showed the mechanism used.

Amongst those taking part in the musical programme were Pipers Munro, Ross and McGregor. Songs were rendered by Messrs. J. M. Dixon, W. A. Sweet, J. T. Webster, H. E. Terry, and speeches by friends of the Association and other visitors.

At 9.45 a.m., August 17th, the meeting was called to order by the president, and a telegram was received from the International Union of Steam Engineers, 152, conveying greetings, and asking the co-operation of the Association in procuring a compulsory license law at the next session of the Ontario Legislature. The convention unanimously pledged their support, and sent a reply to the secretary of the union to that effect.

The report of the Committee on the Good of the Order was then received, and clause 1 was accepted with a recommendation that a clause be added to the Constitution which would cover all future amalgamation of subsidiary lodges. On a vote this was lost.

Clause 3 was also voted down, and the rest of the president's address, with slight alterations, was accepted.

The secretary's report was also taken up, clause by clause, and clauses 1, 2 and 4 were not entertained, but the rest of the recommendations contained in this report met with hearty support.

In view of the change in the name of the Association, it was recommended by Messrs. Wickens and Sweet, that in printing the new Constitution, all changes and amendments that have been made since the last Constitution, were ordered to be inserted, and this was approved of and the following preamble will take the place of the old in the new Constitution:

"This Association having for its object the furtherance of mechanical and expert training of its members, endeavors to strengthen itself by encouraging a higher standard of skill among them.

"In the everyday work of the engineer, there comes an unconscious addition to his past experience by his application to new phases of his labor arising from the increased demands on the uses of steam. How best to acquire the knowledge to meet this march of events in our profession

Doorkeeper, E. Grandbois.

is the principal object of this Association. By means of instructive meetings and circular letters we intend to equip all members, and especially those who may locally be placed at a disadvantage. Fraternity is the spirit of love, and should guide our relations in life. Our labor is so closely identified with capital, that we wish to concede to it the position its commercial interests demand; but recognizes the identity of interests between employer and employee. Our intercourse should be marked with a preference for the furtherance of our progressive life, avoiding all subjects, such as politics or religion, which are man's own private thought."

The meeting was then adjourned to accept the invitation of the Hamilton Lodge for a trip to the other part of the Mountain to view Hamilton from the tower platform of the Mountain View Hotel, and they met again at 2.30 p.m.

The first business was the acceptance of a recommendation by Messrs. Wickens and Dixon, that the Executive should make arrangements for the reading of at least two papers on mechanical subjects, and at least one on social relations at their next annual meeting.

The election of officers was then proceeded with, resulting as follows: President, F. J. Seulthorpe; vice-president, W. A. Sweet; secretary, W. Inglis; treasurer, J. M. Dixon; conductor, W. Outhwaite; doorkeeper, E. Grandbois.

Voting for the next place of meeting gave the honor to Chatham, and the thanks of the Association was voted to the city press, the Hamilton Street Railway Co., International Harvester Co., the Hamilton Cataract, Light, Power and Traction Co., Limited, and also to the Hamilton Association for courtesies extended.

Grants of $2 to the caretaker of the Court House, $25 to the executive secretary were made, and the executive secretary was authorized to send to the St. John, N.B., and Vancouver Associations copies of the Canadian Engineer, containing the report of the convention.

The above group of sketches are from the pen of F. B. Uttley, of the Goldie & McCulloch Co., Galt, who kindly acted as special artist for the Canadian Engineer at the Convention.

A vote of thanks was given A. W. Smith, of the Canadian Engineer, for his services during the convention, and the retiring president, H. E. Terry, was presented with the past president's jewel, and a hearty vote of thanks for his efforts on behalf of the Association, during his term of office, to which he responded with much feeling. With a few words from the new president and others, the convention came to a close.

The following is a list of the officers in the subordinate lodges:

Toronto, No 1—President, W. Onthwaite; vice-president, W. McGhie; recording secretary, H. E. Terry; financial secretary, W. J. Webb; conductor, G. Black; doorkeeper, J. Marr; treasurer, G. Moseley.

Hamilton, No. 2—President, J. Ironsides; vice-president, A. Stewart; secretary, W. F. Crockett; treasurer, W. Cornish; conductor, R. C. Pettigrew; doorkeeper, J. Elliott.

Brantford, No. 4—President, A. Ames; vice-president, T. Pilgrim; secretary, J. Ogle; treasurer, C. Walker; conductor, A. McKinnon; doorkeeper, F. Fordham.

Dresden, No. 8—President, S. M. Seager; vice-president, W. Jamieson; secretary, W. Burnett; treasurer, F. M. Stuper; conductor, T. King; doorkeeper, W. Bear.

Berlin, No. 9—President, J. Walker; vice-president, J. Schneider; secretary, J Heyd; treasurer, W. Geidt; conductor, J. Koehler, doorkeeper, A. Arndt.

Brockville, No. 15—President, W. Robinson; vice-president, J. Grundy; secretary, A. M. Lurkington; treasurer, W. F. Chapman; conductor, V. Hannon; doorkeeper, C. Van Norman.

Waterloo, No. 17—President, G. Beam; vice-president, J. Wendell; secretary, N. Beam; treasurer, J. R. Utley; conductor, J. Nichin; doorkeeper, T. Robertson.

Vancouver, No. 19—President, G. H. Flower; vice-president, J. R. Badger; secretary, W. Keith; treasurer, A. B. Ashworth; conductor, L. Robins; doorkeeper, M. Sprague.

Chatham, No. 21—President, E. Grandbois; vice-president, W. Condon; secretary, Charles Kelley; treasurer, W. Prout; doorkeeper, A. Trott; conductor, J. Buck.

St. John, No. 22—Past president, W. R. Murphy; presi-

dent, E. W. Graham; vice-president, A. Masten; recording secretary, S. Dunham; financial secretary, F. Watson; treasurer, D. A. Halfield; conductor, W. McHarg; doorkeeper, F. Hayter.

Convention Notes.

A member of Hamilton No. 2 placed his steam yacht at the disposal of delegates.

Eureka Mineral Wool Co., of Toronto, have a souvenir pen holder, which they will send to members on receipt of name and address.

The representative of the Syracuse Smelting Co., Montreal, and Toronto, was one of the speakers on the evening of the 16th. Souvenir match boxes were promised from this firm, but did not arrive before the close of the convention. Delegates will please write for them, or call at their exhibit in Machinery Hall at the Canadian National Exhibition.

"TUBE MILLS" IN THE JOHANNESBURG MINES.

From "South African Mines."

To make 100 stamps and a cheap supplemental grinding plant faithfully represent a crushing capacity of 400,000 tons per annum is one of the self-imposed tasks to which Rand engineers have assigned themselves. They have sought and are obtaining the co-operation of what David Gilmour referred to as "the Commercial Engineer." While Mr. Denny is planning high speed heads for the Cinderella Deep, and succeeding with very important innovations at the New Goch, A. M. Robeson, like Mr. Lenz, of Reunert & Lenz, is assiduously devoting himself to perfecting tube mills first introduced into South Africa by Fraser & Chalmers for cement making purposes. All the other engineering firms are no less active in striving to meet the demand for greater efficiency in the mill, and when this has been assured there will probably be requisitions for quick delivery of more hoisting-engines capable of bringing enough golden grist to these reinforced mills.

A few weeks ago South African Mines presented details of the anvil blocks at the Village Deep mill. We are now enabled to present other significant, if not sensational, facts and figures, relative to tube mills and what they promise to do for Rand metallurgy. It will doubtless be recalled that a net gain of 15 per cent. in crushing capacity is confidently anticipated from these new mortar-box foundations, and when it is stated that the firm of H. Eckstein & Co. are anticipating a further increase of 100 per cent. from the use of tube mills in the ratio of four secondary crushers per 100 stamps, some idea of the future metallurgical aspect of these fields may be obtained.

The mining talent of the Rand has for a long time realized that very large tonnages will have to be treated in the epoch of deeper level mining. In this respect the limitations of the stamp head have been ever unpleasantly evident. The ordinary 100 stamp Californian mill under general circumstances will deal with 180,000 tons per annum, and with anvil block mortars it is calculated that this capacity may be brought up to 207,000 tons per annum. Now in the proportion of 25 heads per secondary mill, it is expected to get through 400,000 tons per annum from this same 100 stamp battery. Briefly, this means that the outputting capacity of the Transvaal may be doubled at a very small rate of cost, that this increment will be mostly profit, and that lower grade and deeper areas than those at present considered by the mining world will be brought within the role of profitable mining.

For the first six months of this year practically 4,000,000 tons have been crushed by 4,913 Transvaal stamps. We are erring on the safe side when we say that under the new principles eight million tons would be treated under similar circumstances, that the gold yield would have approximated fifteen millions instead of between seven and eight millions, and that profits would be considerably more than doubled. These figures speak for themselves in an unmistakeable manner, and they may be accepted as emanating from an exceptionally sound authority. It is unnecessary to venture upon calculations based upon our previous estimate of 15,000 stamps in 1909. By that time batteries [illegible] may be displaced by something better.

The fact that the most easterly [illegible] Mines group, although dropping the [illegible] erected, is receiving a complement [illegible] Chinamen, finds solution in this development together with the projected programme that has been sketched for that property. One tube mill is at present running and is doing the work of an additional ten stamps, whilst it may be expected that the relation between stamp and secondary breaker will be brought up to 25 stamps per tube mill when a fully-equipped plant on this new principle with coarse crushing is requisitioned. The average price of such a mill is about £1,000, and when we accept this figure in comparison with the 100 per cent. increase to be expected in 25 stamps, we must realize that the metallurgical engineering has by no means reached its limits to-day, nor is it likely to for some time to come.

What Tube Mills Are.

For the information of the laity, it should be explained that the "tube mill," or what in some countries is termed a "grit mill," is made in various diameters and lengths, and consists of a cylinder of steel plate with a head in each end. There is an inlet in one head and an outlet in the opposite head, the inlet and outlet passing through hollow trunnions fastened to the ends of the cylinder, which trunnions revolve in heavy bearings. The cylinders are usually completely lined with sections of chilled cast iron or steel, and are filled nearly half full with what is termed "iceland pebble." This pebble consists of glacial or water worn flints. The material to be ground is fed in through one trunnion and passes out the opposite trunnion, and the amount of water fed into the inlet governs the quantity of material that is discharged from the outlet. The mills are driven from one end by gears. The cylinders vary in size from 2 ft. in diameter by 10 ft. long to about 7 ft. in diameter by 30 ft. long. The one at the Glen Deep is 5 ft. in diameter by 22 ft. long. This latter would cost about £1,200 landed on the mine. Grit mills have been used for many years, but, we believe, never before in connection with regrinding wet products from stamps. Their usual use in the past has been as a dry grinding mill, such, for instance, as grinding cement clinker, in which case the mills are sometimes lined with wood, and sometimes with bricks made of silica. One mill of the size used at the Glen Deep might be sufficient to grind the portion of the pulp necessary to be ground from 100 stamps. Mr. Robeson, whose technical work is in the direction of perfecting, of supplementing present plants, is understood to be engaged upon further tube mill tests, and it is believed a very great economy will be effected.

Where the Tubes are Used.

At the Pretoria cement works, where dry-crushing is in vogue, the first two tube mills adopted in this country are at work. To G. A. Denny, consulting engineer to the General Mining and Finance Corporation, belongs the credit for first introducing the flint mill into Transvaal mining at the New Goch. At this property the device has proved a notable success. The future Denny idea, as expounded in this journal, has been to slime all products from this mill; at the Glen Deep, where more tubes of improved pattern will be provided, concentrates are to be paid attention to as they are at the New Goch at the present moment. Crushing will be practised with a mesh eight or nine times coarser than that now in vogue, and though increased secondary treatment plants will be necessary, the immense increases in profits that will be possible need no discussion. At the Sheba one of these mills is at work, whilst another is employed at the Treasury, and an instance of the advent of tube mills outside of South Africa is forthcoming in the Waihi gold mine of New Zealand. Discussing the new departure, Mr. Lenz, of Reunert & Lenz, who represent the Davidsen mills, which have recently been the mediums for extensive experiments, says that ten tons per day per stamp is the new milling standard. The secondary breaker he considers a vital element in crushing, and in the rivalry between Rand firms there is the certainty of larger profits, more dividends, prosperity in every department of industry and commerce.

INDUSTRIAL NOTES.

The Brantford Gas Co. is now supplying natural gas from Bow Park.

The Down Draft Furnace Co. are erecting a large building in Galt.

The new bridge across the Fraser at New Westminster has been formally opened.

A large addition to the Shurly & Dietrich Saw Works, Galt, will be built of cement.

Guelph will shortly make extensive improvements in its city hall and market buildings.

The Consumers' Gas Co., of Toronto, has authorized the issue of $1,500,000 new stock.

The C.P.R. oil shed at Brandon, containing sixty-three barrels of oil was destroyed by fire.

It is said that the Canadian Pacific Railway will build a large summer hotel at Bobcaygeon.

The Nova Scotia Steel Co. expect to blow in the new blast furnace before the end of August.

The Bell Telephone Company will erect a fifty thousand dollar addition to their offices in Winnipeg.

The dam of the MacLaren mill, in Wakefield, will probably be improved, and additional power developed.

The C. C. Turner Co., grain merchants, of Winnipeg, are building a grist mill and elevator at Melfort, Sask.

The Ottawa Steel Casting Co. are enlarging their plant by an addition of about eighty square feet, one storey high.

The Bank of Montreal will purchase the Queen's Hotel, Winnipeg, for $220,000, and will erect bank buildings on the site.

Gilbert Plains, Man., has passed a by-law to raise $3,000 to help the Gilbert Plains Milling Co. build and equip a mill.

There is talk of a new gas company entering the field in Montreal in opposition to the Montreal Light, Heat and Power Co.

Orillia has given a contract for a timber dam to Joseph Battle, of Thorold, the work to be finished by October 1st.

Natural gas was recently struck in the vicinity of Sheep Creek, 21 miles south of Calgary, while excavations were being made for coal.

A large addition is being built at the factory of the Hespeler Furniture Company. The firm now employs about 75 hands.

Dixon's foundry at Collingwood was destroyed by fire on July 27th. Loss, about $8,000; insurance, $2,000. Will rebuild immediately.

The Brantford Beaver Oil Co. recently acquired 600 acres in Moore Township, seven miles from Petrolea, and has struck two gushers.

It is estimated that the steel rail mill of the Dominion Iron and Steel Co. will be producing 500 tons of rails per day by the end of the year.

C. N. Oke, expert well-borer, of Petrolea, says oil is to be found near Bowmanville. Arrangements are being made to sink borings immediately.

The Massey-Harris plant in Brantford has been closed down. It is not expected that operations will be commenced before November or later.

The Canada Foundry Co. has closed a contract with the Canadian Northern Railway for the bridge over the Saskatoon, northwest of Battleford.

W. H. Gardner has a contract for new city buildings for Edmonton, buildings to be completed by December 1st. The contract is worth about $10,000.

The first well of the Detroit and Leamington Oil Co. was recently shot. The well was drilled to a depth of 1,072 feet, and within an hour after being shot had filled up with oil for a depth of 500 feet. The owners, the Leamington Oil Co., Limited, is composed chiefly of Ypsilanti people.

Progress is reported in the building of the Dominion Observatory at Ottawa. It is thought that the fifteen-inch telescope will be mounted by October.

The saw and planing mill at Morristown was destroyed by fire with a loss of $5,000, partly insured. The building also contained a sash and blind factory.

The Cramp Steel Co. has turned over to the Northern Iron and Steel Co. its quarry lands and rights to the bonus of $60,000 from the town of Collingwood.

The Dominion Coal Co. are about to secure an extensive water frontage at Halifax, where they will build large coal pockets, and extend the present piers.

The first regular importation of ore from Wabana, Nfld., for the Nova Scotia Steel and Coal Co., was made on August 2nd, when 3,500 tons were landed.

Tenders are asked for the construction of a steel bridge 84 feet in length across the Madawaska, at Calabogie. Bridge to have stone or concrete piers.

The Reid-Newfoundland Co. is just completing a machine shop at St. John's which is 49 x 109 feet. The company is about to erect a car-building shop 42 x 216 feet.

The Dominion Tar and Chemical Co. are considering the erection of an extensive plant for the creosoting of timber in Cape Breton. Louisburg is spoken of as a site.

Messrs. Peter Lyall & Sons, contractors, have purchased a block of land at Longue Pointe, near Montreal, comprising 300 acres, on which they are to erect a cement factory.

An old malt house, at Brockville, recently acquired by the Dominion Government for the marine works of the St. Lawrence, collapsed burying four workmen. None were killed, however.

A local paper reports that a nail manufactory will locate in Sydney as soon as there is some definite assurance that the industrial situation in Sydney is in a settled condition.

The pattern-room of the Albion Iron Works, Victoria, was destroyed by fire on August 9th. It was recently equipped with modern machinery, and the loss is estimated at from $60,000 to $80,000.

The Berlin piano factory has been closed down, due to the foreclosure of a $20,000 mortgage on the factory and plant, and a $7,000 chattel mortgage. The business will be advertised for sale.

The Londonderry Iron and Steel Company have purchased from the Torbrook Iron Company all their deposits at Torbrook, and will commence to ship iron ore at once to their plant in Londonderry.

Wm. Price's lumber mills at Trois Pistoles, Que., were damaged by fire to the extent of $15,000; loss covered by insurance. The damage was principally in the engine-room and interior of adjoining room.

James Munro, managing director of the International Automatic Machine Co., and the Munro Wire Works, of New Glasgow, N.S., has visited Winnipeg with the view of establishing a branch house there.

Manager Shields, of the Lake Superior Corporation, states that the steel works will resume about September 1st. This will involve resumption of work at the Helen mine, and the operation of two smelters.

The Singer Manufacturing Company have awarded to Messrs. Jas. Stewart & Co., of New York, the contract for the erection of their buildings in connection with their removal from Montreal to St. Johns, P.Q.

There is talk of the erection of another palace hotel in Toronto. George Graham, proprietor of the Iroquois Hotel, is said to be behind the proposition, and the site of his hotel, with adjoining land, would be the site of the new house.

A peculiar explosion took place at Pillow & Hersey's Rolling Mills, Montreal, last month. A mass of iron dross being removed from the blast furnace fell into a pool of water and exploded, the fragments being hurled three hundred yards. Three or four people were more or less injured, and small fires were started.

Meaford has granted a loan of $20,000 to the Meaford Wheelbarrow Co., of which James Cleland is president, for the purpose of enlarging and extending their plant. The establishment will employ upwards of one hundred men the year round.

The city council has granted the Canadian Typograph Co., Windsor, Ont., ten years' exemption from taxation provided the company erects a factory, employs twenty men and pays the tax rate on the $5,000 worth of machinery now owned by the company.

In a recent case of damage by backwater against the Gananoque Water Power Co., the judge suggested that the company make an additional outlet of 141 square feet in the dam, to be opened in time of flood. The directors have decided to adopt the suggestion.

Dr. Adams, of Embro, has made an assignment. As he is the principal owner of the Woodstock branch of the Marble-Swift Automobile Co., it is thought that the factory may be closed. The failure is not a serious one, as there are assets far exceeding the liabilities.

A $75,000 sub post-office will be erected on Windsor Street, Montreal, to handle incoming and outgoing mails. It will be connected with the main office by a system of pneumatic tubes which will cost $55,000. Twenty-five thousand dollars is being spent in improvements in the main post-office.

The Department of Railways and Canals is erecting a wood-working machine shop at Cornwall, for the manufacture of lock gates and furnishings for the canals on the upper St. Lawrence. The building will be 92 by 47 feet, constructed of steel faced with pressed brick. J. C. Johnstone, of Cornwall, has the contract.

The Ewart Carriage and Wagon Works, Limited, Toronto, are to be wound up, on the petition of the Dunlop Tire Co. The company was incorporated in February, 1903, with an authorized capital of $100,000, divided into 1,000 shares, of which 294 were subscribed for and 133 paid up. The petitioners have an unsatisfied judgment of $193 against the company.

Brown Bros., Limited, wholesale stationers, of Toronto, who were burned out in the fire of last April, lost their temporary premises by fire on August 21st. The Queen City Curling Rink, which they occupied, was completely gutted, with all its contents. The loss to the company is estimated at $80,000, covered by insurance. The Curling Club and St. Paul's Church are also losers.

Col. T. W. Symons, a member of the advisory board of consulting engineers of the Erie Canal enlargement project, says cement will be used in the construction of locks. It is better than stone, and its use will save several millions of dollars. Col. Symons has just returned from the Trent Valley Canal, where he found the stone parts leaky, but the cement portions beyond improvement.

Cement is beginning to arrive at Fort Frances for the construction work of the Backus Syndicate. 40,000 barrels is the amount of the first order. A power house and wing dam capable of furnishing 1,000-h.p. will first be erected. This will be used for light and power during the work of construction, also for lighting the two towns if they wish it, and will be ready about the first of March. Work will be pushed day and night.

One of the largest cold storage plants in Canada is being erected in Canso, N.S., the contract having been awarded to Mr. James Rice, of North Sydney. The building is to be of brick, 80 by 125 feet, and so arranged as to be extended, if found necessary, later on, and to cost between $40,000 and $50,000. The Dominion Government has granted a subsidy of $20,000. It is expected the plant will be ready for the reception of bait by the 1st of November.

The Canadian Westinghouse Co., who are erecting large shops in Hamilton, intend to heat their buildings by the blast or fan system of heating and ventilating. The contractors for the erection of their buildings, the Westinghouse Church, Kerr & Co., of New York City, have placed the order for four large fans with Sheldon & Sheldon, of Galt The four fans have a combined capacity of handling 152,000 cubic feet of air per minute.

The Canada Foundry Company have closed a contract with the Canadian Northern Railway for a bridge over the North Saskatchewan, north-west of Battleford, at what is known as the Second Crossing. It will consist of eleven spans, and the total length of the steel superstructure will be approximately 1,870 feet, not including the length of the approaches. The total weight of steel entering into the structure of this bridge will be approximately 3,500,000 pounds.

The B. F. Sturtevant Co. is fitting up in its big plant at Hyde Park, Mass., rooms that will be used as an emergency hospital, in case of accident to employees. It is to be equipped with all the appliances known to medical and surgical science for the proper care of the men who may get injured in the discharge of their duties until they can be removed to their homes. A graduate nurse and medical student will be in charge, and a local doctor will attend to all surgical cases.

The Simplex Railway Appliance Company has purchased forty acres of land at Montreal West, and fronting on the Grand Trunk Railway, and will erect a plant employing 1,000 men. The company will make railway cars, steel springs, etc. The Canada Car Co., in which President Hoffstat, of the Pressed Steel Car Co., and W. T. Coleman, formerly second vice-president of the American Car and Foundry Co., are interested, will also build works in the suburbs of Montreal.

The Canadian divisions of the International Brotherhood of Locomotive Engineers met in convention in Montreal on August 10th. Secret sessions were held during the day, and in the evening a public meeting was held, which was addressed by Hon. H. R. Emmerson, Minister of Railways, and by several others. The following two days were spent in examining the C.P.R. and G.T.R. shops and in trips to Lachine and to Quebec. About seven hundred delegates were present.

The various industries of the Lake Superior Co. at the "Soo" are getting into operation. After a suspension of nearly two years, construction has been resumed on the Algoma Central and Hudson Bay Railway Both the blast furnaces, as well as the steel plant of the Algoma Steel Co., are to be in operation this month; and the mechanical pulp mill is making 100 tons of pulp per day. The chemical pulp mill will also be put into operation later on. The charcoal, wood alcohol plants, and acetate of lime plants are now running, their output, being disposed of in advance.

The new Dominion bounty on crude oil has stimulated developments in the oil industry in the Maritime Provinces. An oil field near Memramcook Station, in New Brunswick, is turning out oil in larger quantities and of better quality than the product of the Ontario wells. Thirty-four wells belonging to one company are now producing, and eleven more will shortly be flowing. Natural gas is being found in paying quantities. Dr. H. M Ami, of the Dominion Geological Survey, recently investigated the oil wells in the neighborhood of Moncton, and is very favorably impressed with what he saw.

Among the machinery exhibits at the Winnipeg Exhibition a prominent one was that of the North-West Machinery Co., of Winnipeg, of which Hon. R P Roblin is president, Hon. Hugh John Macdonald, vice-president, and C Vermilyea, manager. The company deals in blacksmiths' and wood-workers' tools and supplies, and in general machinery, and does a trade as far west as British Columbia. The business has expanded greatly since it was taken over from the firm of Vermilyea Bros. & Merrill, in fact, this very expansion is a source of present difficulty, for to handle properly the trade that is offered more capital is needed. Here would seem to be a good opening for a small investment by manufacturers and others who wish to extend their trade west, through an enterprising firm such as this. The company makes an announcement of the subject elsewhere

MARINE NEWS.

The Dominion Government has voted $28,000 to build a new breakwater and improve Toronto harbor.

The SS. Lunenburg, ashore near Sydney, N.S., which, it was expected, would be abandoned, is being repaired at Pictou.

The Dominion Coal Co. has in contemplation the building of steel steamers capable of carrying 1,500,000 to 2,000,000 tons of coal.

The steamer Haddington, recently completed at the yard of the Bertram Engine Works Co., will be managed by J. T. Mathews, Toronto.

The Knapp roller boat is being towed to Toronto, where it will be remodelled into a coal-carrying boat of the ordinary type. It will ply between Toronto and Lake Erie ports.

During July, 5,600,079 tons of freight passed through the Soo canals, establishing a new record. Of the total, 4,817,203 tons passed through the American canal and 710,786 through the Canadian.

The steamer Vega, of Nova Scotia, will be cradled at Anderson's Point, to undergo extensive repairs. Tuck Bros., of North Sydney, have secured the contract for this work.

The car ferry, International, belonging to the Canadian Pacific Car and Passenger Transfer Co., will be rebuilt at the Ogdensburg Marine Railway. The work will require three months.

The Carib II., three-masted schooner built at Shelburne, N.S., in 1901, has made the phenomenal passage of 12 days from Porto Gortez, Honduras, to New York, a distance of 2,100 miles, at the rate of 175 knots a day.

Improvements are being made on Quebec harbor, by the extension of the breakwater by over 900 feet. A suggestion is being made that an additional 500 feet should be also completed at this time, which, if done, will make the extension about 1,500 feet in length.

The British Government Committee on Naval Boilers has issued its final report, after nearly four years of experiments. It declares unanimously that the water tube boilers are more suitable for the navy than the cylindrical, and selects the Babcock and Wilcox and Yarrow types for naval use.

The Augustus B. Wolvin, the largest freighter on the Great Lakes, recently established an unloading record at Conneaut, where she discharged 7,257 tons of ore in four hours and thirty minutes. She has also carried a record-breaking cargo of 10,700 tons of anthracite.

A libel for $14,542.20 has been filed against the Canadian passenger and package freight steamer United Empire, at Grand Rapids, by the Calbick Transportation Co., of Chicago. The libelants allege that their schooner, Herald, sustained damages in a collision with the United Empire, October 10th last.

The Dominion Government has made an agreement with the Submarine Signal Co., of Boston, for the installation of thirty bells in the St. Lawrence and off the coast of the Maritime Provinces, 26 stations to be operated from shore, and four from lightships. Arrangements are being made for the placing of telephone receiving apparatus on ships making Canadian ports. The wires on the ships will pick up sounds from bells at distances ranging from four to ten miles, and it is said that there is no difficulty in determining the directions of the sounds.

There was recently turned out from the Bertram shipyard, Toronto, a new ferry steamer, the Tom Fawcett, of rather a peculiar build. She is 133 ft. long by 33 ft. wide, the great width in proportion to her length being on account of the service in which she is to be employed, which requires ample deck room for cattle, horses and farmers going to market. She is an iron-frame boat with 3-in. oak planking. Her engines are of the compound type, 13 by 26 by 30, with Scotch return tubular boiler 8 ft. in diameter by 9 ft. long. She has feathering paddle wheels. She was built to the order of the Wolfe Island Township Council, and will run as a ferry between Wolfe Island and Kingston. The Bertram Company is now building an iron ferry steamer for St. John, N.B., which will be shipped in sections.

The cruiser Canada built by Vickers, Sons & Maxim for the Dominion fisheries protection service, has sailed for Canada.

The Maritime Board of Trade has passed a resolution petitioning the Government for an ice-breaker to keep Sydney an open port all year.

James Hadden, the "Port Hope Baby," one of the best known sailing masters on Lake Ontario, is dead. Deceased was in his 65th year, and lived with his daughters at Port Hope.

The Black Diamond Line steamer, Bonavista, while lying at anchor at Port St. Francis was struck by the Government tug Eureka, receiving severe damage on her starboard bow, just above the water line.

The hull of the Islander, recently located off Queen Charlotte Islands, will be raised by means of large scows, to which she will be attached at low water, the whole being buoyed by the tide. By repeating the process it is hoped that the hull can be towed to a beach about three miles from where she now lies.

The Dominion Government will improve the harbor at Sturgeon Falls, so as to make the mouth of the Sturgeon river easy of navigation. A dredge with a capacity of 1,000 yards per day, and a tug are to be built at Sturgeon Falls, and will be kept for service on Lake Nipissing.

The Black Diamond SS. Catalone, for Montreal, left the channel, near Maisonneuve, on August 21st, and went aground on the mud. After being lightened considerably, she was pulled off undamaged. The cause of the accident is thought to have been a break in the steering gear. The Catalone is under charter to the Dominion Coal Co., and is one of the largest and speediest of the company's fleet.

WINNIPEG.

(Correspondence of Canadian Engineer.)

Winnipeg has of late often been called the Chicago of Canada. It is, or will be, more to Canada than Chicago is to the United States. Chicago has had to divide its trade and manufactures with other cities of the Western and Central States, but Winnipeg is at present the sole entrepot for the commerce of the vast western Canadian plains, which are now being peopled with a rapidity that is remarkable when compared with any period of our past history. Winnipeg has only to keep its reason and self-control, and avoid being led away by real estate boomsters in order to become a great city. The prediction is confidently made by some of its recent visitors that in ten years from now its population will equal that of the Toronto of to-day. This opinion will not be shared by many who remember the Winnipeg estate boom of 1881-2 and its collapse, and who have no personal knowledge of what has happened in the meantime. But even should the boomsters get control of Winnipeg now the situation will still be different to that of 1881. In 1871, when Manitoba was erected into a Province and the reign of the Hudson's Bay Co. ceased, Winnipeg (the Lower Fort Garry, so named after Nicholas Garry, one of the directors of the old company) had a population of 240 souls. By 1881 a railway had entered the town from the States, and the talk of the advent of the Canadian Pacific Railway, with its line to the Pacific coast, brought a tide of eager speculators along with some settlers from the States, and at one time there was said to be 40,000 people in and about Winnipeg. But the C.P.R. was not completed till four years later, and trade across the customs barrier of the States to the south did not develop. It was like the seed which, planted in thin soil, sprang up, but had not depth enough to take root. It was not based upon sufficient settlement, and markets for the produce of the farm, and so it withered, and by the time the transcontinental did reach it the spirit of Winnipeg was broken, and settlement of the country to the west of it developed but slowly. It seemed that the day of destiny had not arrived. The Western States had not yet been filled up, and plagues

of grasshoppers and early frosts combined with prejudiced reports regarding the climate kept the country back.

But since those days a marvellous change has come over the Canadian West. Cultivation of the land has steadily reduced the risks of injurious frosts, the plague of grasshoppers proved to be a very exceptional and not a common misfortune, and it is now realized abroad that the climate of Manitoba and the whole North-West is at least as tolerable, and certainly quite as healthful as that of eastern Canada; and in the course of my journey I met not a few who stated that they preferred the winter of Manitoba to that of the lake regions of Ontario. The wonderfully rich soil of the country and its heavy yields of grain have made thousands prosperous beyond their first expectations, and to-day the vast plains are being peopled wth settlers who have complete confidence in its future, and who know that a failure of harvest now and then will not affect their ultimate success. Railway building has gone on with the extension of farming, and often ahead of it, till now the map of Manitoba is crossed with lines like the old settled Provinces of the east. Two great transcontinental systems besides the C.P.R. are working west through the Province, and the trunk lines of the northern States of the American Union are keenly seeking a slice of the growing traffic. The fact that these all converge upon Winnipeg would make this city a great centre of trade, but its reawakening is based rather upon the growth of the provincial and territorial towns to the west of it, and the growth of these in turn is based upon the actual wealth produced by the farmers and ranchers in grain and stock-raising. I have no doubt that in course of time the great plain stretching from the eastern borders of Manitoba to the foot-hills of the Rocky Mountains—say, 1,000 miles east and west by 500 to 800 miles north and south—will maintain 100,000,000 people in comfort. It is such conditions and such prospects that are swelling the population and trade of Winnipeg at a very rapid rate. In 1891 the population was 25,639, in 1901 it was 44,778, but at the present time its inhabitants, excluding the floating population, are conservatively estimated from the assessments returns at 67,000. In the last ten years the assessed value of city property increased from $22,001,330 to $48,214,950, while the bank clearings have increased from $50,540,648 in 1894 to $246,108,606 in 1903. The Winnipeg Board of Trade reports the wheat exports to have increased from 15,000,000 bushels in 1894 to 50,000,000 in 1903, so that, taking this staple as an index of business, the growth of Winnipeg has not outpaced but rather lagged behind the growth of the agricultural interests, upon which the city's trade is based.

The city of Winnipeg is now an anthill of transformation and reconstruction. Everywhere in the central portions of the city old warehouses are giving place to newer and greater ones, banks and insurance companies are reorganizing their business and putting up more solid and expensive headquarters, and the era of the sky-scraper has begun. The Canadian Pacific Railway Co., with unabated faith in the country with which its own vast growth is so intimately bound up, is building a great terminus with an eight-story hotel, 236 feet long, and having 315 guest chambers. These will cost about $1,500,000, and will include a subway for city traffic along Main Street, which the railway will cross. This subway will cost between $80,000 and $100,000, is 100 feet wide, having two arches for sidewalks and street traffic and one arch for the street railway. Eight railway tracks will cross this subway. The company has also purchased land in the western part of the city, where it is building railway shops, roundhouses and freight sheds. The sheds will be 1,800 feet long, the roundhouse will contain forty locomotive stalls, and the shops and yards eighty-four miles of track. The shops will be extensive, and will be used for building both passenger and freight cars as well as for repairs. The Canadian Northern Railway and the Grand Trunk Pacific also have plans for extensive terminals and works, though these plans may be modified if the railway commission's recommendation for a Union Station is carried out. It is expected that the new subway will be finished in October, and the new C.P.R. station ready for occupation about February [illegible]. The [illegible] Street Railway Co. is also building a subway in [illegible] Street, and has started work on new car and repair shops, including a main building 250 x 100 feet, with boiler and engine room and heating plant, to be finished by October, 1904. These are a few of the semi-public features of the industrial development that has now begun. As to the progress of building in residential quarters, I may cite an instance that came under my own knowledge. The hotels being overcrowded during the Exhibition, I obtained lodgings in Langside Street. In the portion of this street running south from Notre Dame there were over 700 numbers on the houses, and yet the oldest house in the street was less than two years old. My hosts informed me that last year they sat at their back door in the summer evenings and watched the boys playing baseball in the field adjoining, but now there is no adjoining field, for it is all laid out in streets and partially built up. It is at once evidence of the almost reckless progress of building and of the tolerable character of the winters here to add that many of the houses going up are of a frailty that would seldom be found in eastern cities. The excuse for this is that the high rents and great demand for houses force even poor people to buy and build on the instalment plan in order to have a house at all. The building permits taken out in Winnipeg for the first six months of 1904 made a total of over $6,000,000. Astonishing as it may seem, none of the big cities of the United States reached this record in building this year, and only one exceeded it—the city of New York. It is worth while to notice, by the way, that alert Yankees are taking a more prominent hand in investment in Winnipeg and even in investments in farm lands in some districts to the west—than eastern Canadians. One cannot be surprised at this, for where the remembrance of the boom of 1881-2 lingers in the minds of the many Ontario and Quebec people who invested to their loss there is apt to be severe skepticism about the reality of rising values in the same field. I had the same prejudice, but, having seen the city and its recent Exhibition, that prejudice is gone, and hence I would advise eastern Canadians to come and see for themselves, and then judge what the development of this western country will mean a few years hence to them as manufacturers, capitalists and colonists.

The Winnipeg Exhibition, this year called the Dominion Exhibition, was a revelation of the potentialities of the West. The show of horses, cattle, and sheep has never been excelled, if equalled, on the continent, while the array of agricultural machinery, covering in all a space of ten acres or more, was a striking exhibit of the revolution in mechanics as applied to agriculture. The manufacturers of the East are evidently waking up to the march of events here, as they had four buildings nearly filled with machinery and goods "made in Canada," these being shown under the auspices of the Canadian Manufacturers' Association, under the supervision of C. B. McNaught, of Toronto, whose services were recognized by the presentation of a purse of $300 in gold, along with a shower of compliments. Mr. Heubach and his active staff, who managed the show, have proved able exhibition men, and have rendered a service to the whole Dominion in presenting to the East a spectacle of what the Canadian West is capable of.

In a succeeding issue I hope to deal with other developments in the West.

MINING MATTERS.

A ten-stamp mill will be erected at the Redeemer mine, near Dryden. Water power will be used.

It is expected that the Ontario Government Railway will reach New Liskeard about the 1st of September.

The Tyee Copper Co., of British Columbia, recently declared a dividend of 10 per cent. for the year. The main shaft is now down 483 feet, and favorable changes in the rock are being met.

A seam containing a large supply of coal of good quality has been discovered at Whales' Head, Belle Isle Straits, Nfld.

It is reported that a 400-lb. nugget of silver was found at Cobalt a few days ago, and that a very rich vein of silver has been struck in another mine there.

The equipment of the overhead conveyors at Talcville, Nfld., is progressing, and it is expected that operations in the talc mines will begin in September.

The Granby Consolidated Co. will spend $75,000 in building ore bins and putting in two new crushers. Extensions to the smelter will probably not be made this year.

The Privy Council has allowed the appeal of the Calgary and Edmonton Railway, claiming that minerals go with the land in a Crown grant. The company thus becomes possessed of all minerals on its lands except gold and silver.

It is reported from Wabigoon that B. J. Morningstar and G. Palmer, examining the McRae property on Minnehaha Lake, have made a remarkable gold find. The principals are the Minnehaha Mining and Milling Co. It is said that the property will be developed immediately.

Plans for a corundum mill of one hundred tons' daily capacity, to be situated at Palmer Rapids, Renfrew County, have been accepted by the Corundum Refiners, Limited, in Toronto, last week. The construction of the mill will be begun at once, and it is expected to be in operation next summer.

Some fine samples of ore were brought into Rat Portage recently from the Sultana mine on the Lake of the Woods. The ore was mined from the 400 feet level and showed unmistakeable signs of visible gold. Forty-five men are now engaged on the property, and 20 stamps have been in operation during the summer.

Since 1896, nearly $97,000,000 worth of gold has been shipped out of the Yukon, according to the annual report of the Dominion Geological Department, which has just been issued. The production in 1903 was $12,250,000; in 1900 it was over $22,000,000. The decline is due to the exhaustion of the best deposits, from which practically all this gold has been secured.

E. J. Davis, Ontario Commissioner of Crown Lands, replying to a letter from labor bodies of Guelph and Toronto, stated that the indications are that there are coal deposits in Northern Ontario, but there are doubts as to whether it will be anthracite of the best quality. Until the railway system is extended, it would be difficult to develop such deposits, but if valuable discoveries are made, such regulations will be provided as will protect public interests from monopoly.

On August 2nd six men lost their lives at Shakespeare Mine, Webbwood, Ont. A blast was fired at six p.m. of the previous evening, and the air was not blown into the mine as usual. At seven in the morning the miners descended, and one after another were overcome and dropped dead off the ladder without the opportunity of warning those following. The dead are: N. MacMillan, mine manager; Peter Reid, mine engineer; John Walters, John Disby, Peter Grant, and Edward Latour, miners. The inquest showed that the accident was due to carelessness. Carbon monoxide was the fatal gas.

J. Walter Wells, mining engineer, Toronto, has been investigating for the Geological Survey the lime, clay and shale deposits of Manitoba in the interests of the cement industry. At present there is only one cement factory in Manitoba, but if new marl deposits are found, other works will be put up in view of the large building operations now going on in the Province.

St. John's, Newfoundland, Herald: Parties who were placing great faith in the gold discovered in White Bay are fast losing hope that it will ever develop sufficiently to pay one-quarter the cost to date. At one place, where a sum said to be in the vicinity of $40,000 has been expended, so little was received in return that work will close down. Another claim has been completely abandoned, while those who have sent prospectors over the ground have failed to get a report of sufficient material to warrant expenditure of any more money. This is a serious drawback, where so much was expected.

It is said that at the York Harbor copper mine, Newfoundland, the largest seam ever discovered on the island is now being opened up.

A party of eminent United States and Canadian geologists has been visiting Michigan, Wisconsin, Minnesota and New Ontario with the object of preparing jointly a new geological map of those districts. The party visited the Rainy Lake and Lake of the Woods districts of Ontario, last month. Dr. Robert Bell, director of the geological survey, Ottawa, was in charge, the other members of the commission being Dr. Adams, of McGill University, Montreal; Prof. Miller, of Kingston School of Mining; Prof. C. W. Hayes, head of the United States Geological survey; Prof. C. R. Van Hise, president of the University of Wisconsin; Prof. C. K. Leith, of the United States geological survey; Prof. A. C. Lane, state geologist of Michigan; Prof. A. E. Seaman, Michigan School of Mines.

Charles Henry Tyrell, of the Geological Survey, Ottawa, has returned from an exploration expedition in the Edmonton district in search of coal deposits and gas. Mr. Tyrell, in passing through Winnipeg, said to a Free Press reporter that there should be plenty of gas, salt, coal and oil in Manitoba and the North-West Territories. Many indications of these resources were discovered in various places, and it is likely that Ottawa capital will be subscribed to develop it. "Up to now the surface only has been tapped, but where conditions similar to those which prevail in the North-West are found there are usually things below the ground. In Russia the table lands produce oil and gas, and there is reason to believe that these prairies are undermined with a strong flow of petroleum. I found large chunks of 'brearer' near Reaburn, and also in the Edmonton district. These samples I have with me, and from what I can discover I am led to believe that the Pennsylvania wells are only the eastern extremity of an immense vein which extends from the far north-west, passing just north of Edmonton in a wavy line, almost touching Winnipeg, and going east into the States in the vicinity of Kingston or Ogdensburg, which are on the western extremity of a new limestone formation. From Winnipeg the line of oil deposit must run south and dodge the Huronian rocks which extend through western Ontario."

T. W. Gibson, director of the Ontario Bureau of Mines, has returned from a visit to the nickel region of Ontario. He reports that the Canadian Copper Co. is completing its new plant at Copper Cliff. The company draws most of its ore from the Creighton mine, five or six miles distant. This mine, which has the largest and richest body of nickel ore in the world, is being worked as an open cut. The opening is about 250 by 300 feet in area and 60 feet deep, practically all ore. About 80 ft. below this a second level has been opened, which has been broken through to the floor of the first level, the intention being to stope out all of the area between. It is also proposed to open another smaller pit about 500 feet distant on the ore body. There are between 250 and 300 roast heaps of ore burning in the Copper Cliff roast yards. The Mond Nickel Company is operating the North Star mine and conveying the ore to Victoria mine. The Bessemerizing part of the Mond Company's plant is being used to treat the Canadian Copper Company's matte, pending the installation of converters in the latter company's works. Mr. Gibson, in an interview to the Globe, states that he visited the Massey Station copper mine, where some five levels have been run, a large quantity of moderate grade ore being found. The Hermina copper mine, where the shaft is down 140 feet, is being sunk on a a rich but somewhat narrow vein of copper ore. At the Shakespeare gold mine, near Webbwood, work is being vigorously pushed. The ore pans gold readily, even where there is no visible gold. The development of water power is making considerable advance in New Ontario. At Webbwood, on the Spanish river, the pulp company is arranging to utilize several thousand horse-power. At the High Falls on the Spanish river also the development of power is rapidly progressing. At Wahnapitae, the Canadian Copper Company has almost completed an extensive power plant, and at Vermillion considerable power is to be utilized for lighting Sudbury and for the supply of power to that town.

The Cordova gold mine, near Marmora, Ont., belonging to the Cordova Exploration Co., is being pumped out, and operations will be resumed in a short time. The mine has been idle for some months.

Twenty thousand dollars were shovelled in by two miners at No. 10 Eldorado Creek, Yukon, on August 7th and 8th. The clean up was a big surprise, as the claim has been worked continuously since 1897.

The Cape Breton Coal and Iron Company has sold its property at Caherone's Lake to an English corporation, which will at once proceed to operate them. Louisburg will be the new company's shipping point.

A coal property at Boularderie Centre, N.S., is being developed. The coal is much harder than that at Sydney Mines, and appears to be free from shale. A. J. Nicholson, of Barrasois, has several men steadily employed on the property.

Shipments of coal from North Sydney have decreased this summer. This is said to be due to the delay in clearing the wharves at Montreal, local coal dealers allowing their supplies to remain at the dock. A rush of shipments is anticipated about the end of the St. Lawrence season.

The Federal Government will shortly be petitioned by the Yukon miners to assume the solution for them of the water problem. If water can be brought in sufficient quantity and at a fair price from the hills, thirty miles distant, it is held hydraulic mining in the Klondyke district will yield fortunes for another half century.

Iron ore from areas at St. George's Channel, N.S., have been assayed and found to contain 60 per cent. hematite. Joseph Frye, of Boston, is now proving the property, which will be purchased by the Dominion Iron and Steel Co., as soon as it is proved to contain a sufficient quantity to warrant its being operated. The deposit is situated at tide water.

Supt. T. J. Brown and Manager Robert Robson, of the Nova Scotia Steel and Coal Co., have located the outcrop of the main seam of coal at Point Aconi. The discovery assures a supply of coal for years to come. It is probable that the mine will soon be opened in the Point Aconi district. The outcrop was found three miles from the place where experts had calculated that it should appear.

Several parties are prospecting for hematite iron ore in the neighborhood of Loon Lake, Thunder Bay district. Indications of this ore, which is in the same formation as the Messaba Ranges, were noticed several years ago. Of several shafts sunk, the deepest is about 30 feet. In the same district, the "Sunbeam," or "No. 282" gold mine, which was worked several years ago, has been reopened this summer with 10 stamps running.

Just before the Boer War, an important discovery of tin was made on the borders of the Transvaal, but during hostilities no efforts could be made to properly test the ore, but a report has now been sent to "South African Mines," giving an analysis of the ore, which shows that it will be amenable to the ordinary methods of tin dressing, and that it is comparatively free from iron compounds. If the Transvaal is found to be rich in tin as well as in gold, coal and diamonds, it will be a land of mineral wonders.

INSTITUTION OF CIVIL ENGINEERS.

As announced in our July number, about two hundred members of the Institution of Civil Engineers of Great Britain will visit Canada and the United States this month. According to the circular issued by the secretary of the Institution of Civil Engineers to members respecting the arrangements, the party will leave Liverpool on the Cunarder Etruria, September 3rd, reaching New York about the 10th. A formal reception will be given by the American Society of Civil Engineers at their rooms, New York, after which the visitors will inspect the Rapid Transit Subway. Excursions to various points will take place, and a dinner will be given by the American Society on the 16th. A special train will leave New York on Monday, September 19th, and will travel over the New York Central to Montreal, where a week will be spent visiting, under the guidance of the Canadian Society of Civil Engineers, some of the principal objects of interest in the east of Canada, and the week will be very fully occupied. On Tuesday, September 20th, the Canadian Pacific workshops will be inspected. On Wednesday, September 21st, the Soulanges canal will be visited by steamboat, the return to Montreal being made by way of the Lachine rapids. In the evening there will be a reception at the McGill University. On Thursday, September 22nd, a visit will be paid to Ottawa. During the night the party will travel to Quebec. On Friday, September 23rd, the time will be spent at Quebec, and inspection will be made of the Chaudiere power development, and of the bridge in course of construction over the St. Lawrence. On Saturday, September 24th, the party will travel from Quebec to Toronto. Sunday and Monday, September 25th and 26th, will be spent at Toronto, and on Tuesday, September 27th, a visit will be paid to Niagara Falls, where the power development and allied industries on both the Canadian and United States sides will be inspected. In the afternoon the party will travel to Chicago by way of Port Huron or Detroit.

After the tour through Canada, which terminates at Niagara Falls, September 27th, the engineers will proceed to Chicago, reaching that city the day following. The same day, together with the following one, will be given to the inspection of objects of interest there. On Friday, September 30th, the party will travel by special train over the Wabash Railroad to St. Louis. No general programme has been proposed for the period to be spent in this city, but visitors are cordially invited to attend the International Congress, which will be held there from October 3rd to 8th, under the direction of the American Society of Civil Engineers.

SEPTEMBER CONVENTIONS.

The fourth annual convention of the Union of Canadian Municipalities will be held in London, Ont., September 20th, 21st and 22nd. Among the special papers to be presented will be: "Special Civic Charters in Canada," by S. Morley Wickett, Ph.D., Toronto; "Park Possibilities in Canadian Cities and Towns," by F. G. Todd, landscape architect, Montreal. Other topics to be discussed are insurance rates, water supply, municipal ownership of public utilities, level crossings and good roads, drainage and sewage problems, etc.

The Structural Iron Workers will meet in convention in Toronto on September 20th, and continuing for about a week. This convention will open the new Labor Temple on Church Street. About 225 delegates are expected.

The Master Steam Boiler Makers' Association will meet in annual convention in St. Louis, September 6th, 7th, 8th and 9th.

The National Electrical Contractors' Association of the United States will hold their annual convention at St. Louis, September 14th, 15th and 16th.

An International Electrical Congress will be held in St. Louis, September 12th to 17th. More than 100 special papers will be presented. Dr. A. E. Kennelly, Harvard University, Cambridge, Mass., is the general secretary.

The Canadian Manufacturers' Association meets in Montreal, September 20th, 21st, and 22nd.

GRAND TRUNK PACIFIC ORGANIZATION

The Grand Trunk Pacific Railway was organized on August 10th at the first meeting of the shareholders and directors at the general offices of the Grand Trunk in Montreal. Mr C. M. Hays, general manager of the G.T.R., was elected president, and Mr Frank W. Morse, third vice-president of the G.T.R., first vice-president and general manager. The other officers are: Mr William Wainwright, second vice-president; Mr Henry Phillips, secretary; Mr Frank Scott, treasurer, and Mr H. W. Walker, general

auditor. These are also officials of the G.T.R., Mr. Wainwright being comptroller, Mr. Phillips secretary to Mr. Hays, Mr. Scott treasurer, and Mr. Walker general auditor. Members of the Executive Committee are: Messrs. C. M. Hays, Hon. George A. Cox, F. W. Morse, and W. Wainwright.

Following are the directors who were named: C. M. Hays, F. W. Morse, W. Wainwright, W. Y. Biggar, Hugh A. Allan, and E. B. Greenshields, of Montreal; Sir Charles Rivers-Wilson, Lord Welby, Col. Fred Firebrace, Alfred W. Smithers, and John Alan Clutton-Brock, of London, England; Hon. George A. Cox and E. R. Wood, of Toronto; John R. Booth, of Ottawa, and John Bell, of Belleville.

On August 14th the officers and directors left on a trip to the West. A short time was spent at Fort William and Port Arthur inspecting sites for a terminal, Bare Point being urged as a suitable site by Port Arthur residents. The party will be joined by Hon. Mr. Prefontaine, Minister of Marine and Fisheries, in the examination of sites on the Pacific coast. There are three points proposed, Port Simpson, Kitimat, and a third harbor also south of Port Simpson.

On August 18th the personnel of the Transcontinental Railway Construction Commission was announced by the Government as follows: F. B. Wade, K.C., Annapolis, N.S., chairman; Alfred Brunet, Montreal; Robert Reid, London; C. A. Young, Winnipeg. It is reported that P. E. Ryan, secretary to the Temiskaming Railway Commission, has been appointed to act in a similar capacity to the present commission. H. D. Lumsden, of Toronto, is the chief engineer, and Premier Parent, of Quebec, the Government representative on the Grand Trunk Pacific directorate.

The chairman of the Commission, Mr. Wade, will receive $8,000 per annum, and each of the other commissioners $7,000. The stipend of the chief engineer will be $6,000.

Mr. Parent, as Government representative on the directorate, is with the company's party travelling in the West.

The first annual meeting of the company is called for September 20th, in Montreal. The report on terminals will probably be presented at that meeting.

With regard to construction, Hon. Mr. Prefontaine recently made the following announcement in Vancouver: "The surveys have been almost completed, and it is the intention of the authorities of the Grand Trunk Pacific Railway to begin construction at both ends of the line from Winnipeg west and from the Pacific coast towards Winnipeg, and it is the intention of the Government, who have control of the construction from Winnipeg to Moncton, to begin construction from Winnipeg east and from Moncton west." It is stated that the presence of J. R. Booth on the directorate has no significance as indicating the absorption of the Canada Atlantic by the new line.

MUNICIPAL WORKS, ETC.

Burk's Falls is installing a waterworks.

A trunk sewer three miles long is being laid in Winnipeg at a cost of $200,000.

Brighton has defeated a by-law to purchase $20,000, first mortgage bonds of the Ontario Electric Railway Co.

Work is being pressed on the new waterworks and the electric light station at Moose Jaw, which are to be finished by the end of the year.

It is expected that before October 1st, a by-law will be submitted in Kingston for the expenditure of about $100,000 for improvements to the lighting plant.

Portage la Prairie, Man., has called for tenders, open till the 7th September, for 40,000 feet of water mains and 36,000 feet of tile sewers. Willis Chipman, Toronto, is chief engineer.

The Cape Breton Electric Co. recently advanced rates in Sydney, and this fact has brought up the question of municipal ownership. The city council is now investigating the legality and cost of establishing a plant.

The first annual report of the Guelph Fire, Water and Light Commission shows a net profit of over $10,000. A new boiler will be placed in the power station, and an expenditure of $5,000 in improving the waterworks is proposed.

The St. Thomas city council's offer of $29,000 for the gas and electric plant has been refused by the Gas Company. The company has appointed an arbitrator to be one of three to fix a price if the city still desires to purchase the plant.

Berlin is building two septic tanks and two storage reservoirs, 150 by 36 feet, and seven feet deep. These, with the existing tank, will give a total capacity of 530,000 gallons. Casper Braun has the contract, his price being $16,400. The tanks are to be completed by October 1st.

Brandon, Man., is enlarging its waterworks. The present pumping station, having a capacity of 1,500,000 gallons per day, is moved to a higher site, and two new pumps are being installed to increase the capacity to 3,500,000 gallons. Underlying the station is a bed of sand, which will be utilized for filtering the water. Plans are being made for a sewerage system for the city.

LIGHT, HEAT, POWER, ETC.

Ottawa has closed its contract with the Ottawa Electric Co. for street lighting for ten years at $52 per light per year.

The Beamsville sub-station of the Hamilton Cataract Co. was recently damaged by lightning to the extent of about $1,000.

The Sydney Mines (C.B.) Lighting Co.'s plant began operation the first week in August. There are at present 110 32 c.p. street lights.

The Canadian Niagara Power Co. has given a $5,000,000 mortgage to the Toronto Trust Co., covering all the company's property, plants, privileges, etc.

R. T. Swales, temporarily acting as night constable at St. Mary's, was found dead in the basement of the Town Hall, grasping the cord of an electric bulb.

Before the end of September it is expected that an addition of 5,000 horse-power will be delivered by the Hamilton Cataract Light, Power and Traction Co.

The Hamilton Cataract Power, Light and Traction Co. have completed the enlargement of Lake Gibson. The lake now covers seventy acres. St. Catharines will be supplied with water from this reservoir.

St. John, N.B., is thinking of buying the lighting station of the Carleton Electric Co. for $21,000. The city at present pays $105 per light to the Carleton Co., whereas the St. John Railway Co.'s lights cost only $85.

Ottawa has changed its agreement with the Metropolitan Electric Co. so that it has not the right to acquire the property of the company until 1914 instead of 1908. This change was made at the request of the company in order to facilitate financing.

James Tetley, an electrician in the employ of the Toronto Electric Light Company, met his death in the cellar of his house, on August 20th, by an electric shock. An electric light wire at the corner of the street broke and fell across a street railway feed wire. Soon after this something went wrong with the lights in Tetley's house, and he went down cellar to investigate. When found, he was lying dead, clasping a light bulb in his hand. An inquest was considered unnecessary, as there was no evidence of negligence.

PERSONAL.

J. F. H. Wyse, formerly with the Brantford Electrical and Operating Co., is now practising in Toronto, as consulting, electrical and hydraulic engineer. His address is 16 King St. West.

W. S. Edge, divisional engineer of Mr. Schwitzer's office, has been appointed to the vacancy in the engineering department of the C.P.R. caused by the untimely death of W. T. Laing at Killarney, Man.

Alan M. Jones, till recently assistant engineer of the Illinois Central Railway, has been appointed a locating engineer of the Grand Trunk Pacific, and is now in Manitoba.

Bendt Q. Bay, a Danish engineer in the employ of the C.P.R., was killed while engaged in the construction of a bridge at Woodbridge. He fell under the wheels in getting off a train.

Albert H. Kirkpatrick, superintendent of construction for E. Leonard & Sons, London, Ont., was killed by falling into a fly-wheel in Prince Albert, Sask., where he was installing the electric light plant.

No successor has been appointed to Geo. Mountain, till recently chief engineer of the Canada Atlantic Railway. The general superintendent, M. Donaldson, assumes supervision of the track department for the present.

P. W. St. George, C.E., Montreal, has been appointed as engineer on behalf of the Department of Marine and Fisheries during the construction of the new permanent sheds for Montreal harbor at a salary of $3,000 a year.

John J. McGill, formerly manager of the Canadian Rubber Co., of Montreal, and now president of the Dominion Belting Co., of Hamilton, has been nominated for the presidency of the Montreal branch of the Canadian Manufacturers' Association.

R. C. Carter, of Kingston, general manager of the Bay of Quinte Railway, the Oshawa Railway, the Thousand Islands Railway, and the Deseronto Navigation Company, died at the Royal Victoria Hospital, Montreal. He was 60 years old and had been suffering from a paralytic stroke. Besides his connection with transportation companies, Mr. Carter was a director of the Canadian Portland Cement Company and of the Rathbun Company, of Deseronto.

Alexander K. Kirkpatrick, city engineer of Kingston, has resigned that position to take the appointment of professor of civil engineering in the School of Mining of Queen's University, Kingston. Mr. Kirkpatrick graduated from the Royal Military College in 1882, and for seventeen years was on the engineering staff of the C.P.R., for part of which time he was division engineer in Toronto. In 1899 he went to Egypt as chief engineer of Egyptian railways and the port of Alexandria. For personal reasons he returned to Canada when offered the city engineership of Kingston in 1900. For three sessions he has been lecturer on railway engineering at the School of Mining.

With regard to the communication in last issue respecting a certain appointment to the engineering staff of the Public Works of the North-West Territories, Mr. Wiggins writes that he did not lay claim to the position of Assistant Chief Engineer of Public Works, N.W.T. The report that he had received this appointment was published in several papers in Manitoba and the North-West Territories, and, as Mr. Macintyre says, the returns made to the Canadian Society of Civil Engineers credit Mr. Wiggins with the same post. Mr. Wiggins explains that his position is that of District Surveyor and Engineer of the Public Works Department for the district of Centre Assiniboia.

A. J. deB. Corriveau, of Montreal, was killed by a street car in that city on August 6th. He was running diagonally across the street when struck by a car and thrown to the pavement, fracturing his skull. The coroner's jury finds that the fatality was an accident, no blame attaching to the motorman. Deceased was born at St. Thomas, Quebec, and was 54 years of age. He established the Corriveau Silk Mills in Montreal, 25 years ago. He was later in the employ of the Royal Electric Company and the Montreal Street Railway Company, and it was he who initiated the idea of the Montreal Park and Island Railway. During the past few years he was interested in the automobile business, and was one of the first to introduce the automobile in Montreal. He was interested in canals also, having secured a charter for a canal connecting the St. Lawrence river with the Richelieu. Mr. Corriveau was a very energetic man, and was never known to lose a day through illness. Mr. Corriveau was the projector of the first silk mill in Canada, and suggested and promoted the first electrical convention as well as the first street railway convention in Canada.

Thomas B. Tate died recently at [illegible] ninety years. Mr. Tate ran the [illegible] Canada, called the St. Lawrence [illegible], he built the Brighton and Norman [illegible] the construction of the Grand Trunk [illegible] Kingston. He was chief engineer of the [illegible] dam to Potsdam Jct., and also the [illegible] the official map of Ogdensburg, and [illegible] every town in St. Lawrence Co., N.Y. [illegible] in England, and came to America in 1818 [illegible] in Ogdensburg and a daughter in [illegible].

Marcus Smith, M.I.C.E., of Ottawa, died [illegible] in his ninetieth year. Mr. Smith was born [illegible] on-Tweed, Eng., July 16th, 1815, and studied for his profession there. After several years spent [illegible] and railway work in England and Wales [illegible] America, settling first in the United States [illegible] Canada, he continued in municipal work, making surveys and maps of several cities and towns, including Hamilton, Dundas, St. Catharines, Galt and Brantford. Taking up railway work, Mr. Smith did considerable work on the location of the Sarnia, Hamilton and Toronto branches of the Great Western Railway, now a part of the Grand Trunk system. In the following years he was engaged in railway work in Cape Town and England, returning to Canada in 1868. He was called back to this country to take a position on the staff of Sir Sandford Fleming on the construction work of the Intercolonial Railway. He had charge of a section leading from Bathurst. This position Mr. Smith resigned to accept that of deputy to the engineer in chief of the Canadian Pacific Railway, when he was immediately despatched to take charge of the surveys in British Columbia. Mr. Smith's ability was further recognized when, in 1876-78, he was appointed to act as engineer in chief during the absence in England of Sir Sandford Fleming. He had charge of several important surveys on the line in British Columbia. In 1886 his connection with Canada's great transcontinental railway ceased, but he continued until 1892 in the public service as a consulting engineer. Mr. Smith was elected an associate of the Institute of Civil Engineers of England in 1866.

The Intercolonial will build a $70,000 station at Sydney, C.B., to be finished by June, 1905.

—The United States has inaugurated a Government wireless telegraph line from Nome to St. Michael's, Alaska, a distance of 107 miles.

—The Pacific Wireless Telegraph Co. is equipping a station at Victoria, B.C., which, it is hoped, will be open for commercial despatches in about a month.

Owing to a disagreement as to the price of water supplied by Stratford, the Grand Trunk is installing its own water supply plant in that city. The plant will cost $20,000.

The new shops of the G.T.R. at Stratford, Ont., are to cost $170,000, and to be completed by the end of December, when the staff of hands will be increased by about a thousand men.

The Railway Commission, at its sitting in Winnipeg, declared its policy to be in favor of a Union Station in that city, capable of accommodating not only the two railways at present there, but others likely to reach the city in the future.

A boiler explosion at the Kinleith Paper Co.'s mill, at St. Catharines, wrecked one of the buildings. The boiler was a rotary rag boiler, receiving steam from the main boiler in another building. The cause of the explosion is unknown. The loss is estimated at $15,000.

NEW INCORPORATIONS.

The British Columbia Gazette announces the incorporation of the following:

The International Roller Bearing Co., with a capital of $25,000, to manufacture the Kincaid Patent Roller Bearings.

The British Columbia General Contract Co., capital, $50,000.

The Standard Oil Co., of British Columbia, capital, $1,000,000.

Northern Gold Mines Co., capital, $1,500,000.

The North-West Territories Gazette announces the incorporation of the Weyburn Telephone Co.

Consolidated Spruce Creek Placers, Limited, of Seattle, Wash., has been licensed to do business in British Columbia.

The British Columbia Gazette announces the following incorporations:

Flathead Valley Oil Lands Development Co., capital, $250,000.

British Columbia General Contract Co., capital, $50,000.

Dundee Gold Mine, Limited, capital, $25,000

British Columbia Foundry and Engine Works Co., capital, $100,000.

Elk River Coal and Oil Co., capital, $25,000.

Eva Gold Mines, Limited, capital, $500,000.

Ross & Howard Ironworks Co., capital, $250,000; to take over the business of Ross & Howard in Vancouver.

Georgia Rock Co., capital, $10,000.

Green City Mining Co., capital, $100,000.

The Canada Gazette announces the following:

Canadian Lowe Coke and Gas Co., capital, $1,000,000; head office, at Montreal. Incorporators: A. W. G. Macalister, W. J. Henderson, W. G. Mitchell, G. E. Clark and G. H. Semple.

St. Lawrence Coal Co., capital, $500,000; head office at Montreal. Incorporators: C. Brandeis, J. S. Buchan, and W. H. Olive.

Pennsylvania Coal Co, capital, $20,000; head office at Montreal. Incorporators: Senator Mitchell, L. E. Kimpton, H. L. Mitchell, H. P Mitchell, and R. T. Heneker.

St. Lawrence Construction Co., capital, $20,000. Incorporators: J. Ethier, A. Dansereau, A. Secompte, and H. Audette.

Kent Oil Co., capital, $100,000; head office, at Harcourt, N.B. Incorporators: H. Von Hagen, of New York; M. F. Keith, of Harcourt; W. R. Townsend, of Moncton, and others.

The Consolidated Plate Glass Co. is now empowered to manufacture glass.

The Canada Gazette announces the following incorporations:

The Railway Spring and Supply Co., capital, $49,000; head office at Montreal. Incorporators: J. Rogers, C. Coughlin, F. D. Shallow, P. M. Wickham, and J. A. Rowan.

The Bonanza Creek Hydraulic Mining Co., incorporated in Great Britain, is authorized to do business in Canada.

The Rainy River Navigation Co. has increased its capital from $90,000 to $150,000.

Hillcoat Bearing Co., capital, $20,000; head office at Amherst, N.S. Incorporators: H. V. Hillcoat, F. L. Blair, A. J Crease, H. A. Hillcoat, and J. W. Taylor, all of Amherst.

Cie d'Aqueduc et d'Eclairage de Belœil is incorporated at Belœil, Que., with a capital of $20,000. Incorporators: I. Prefontaine, C. Guertin, J. Malo, and others.

Canada Rolling Stock Co. is incorporated at Toronto with a capital of $250,000. Incorporators: N. Curry, N. A. Rhodes, Hon. T. R. Black, and others, all of Amherst, N.S.

The Ontario Gazette announces the following:

The Trussed Concrete Steel Co., of Michigan, is licensed to operate in Ontario, A. R. Bartlet, of Windsor, being attorney.

The Godson Contracting Co. is incorporated at Toronto with a capital of $100,000, the incorporators being, Margaret Godson, F. W. Godson, A. F. Godson, and others.

Colborne, Ont., has passed a by-law to loan the Ontario Electric Railway $150,000.

* * *

The price of residence telephones in Ottawa has been reduced from $30 to $25 by the Bell Telephone Co.

* * *

The conclusion of W. L. McFarlane's paper on A. C. vs. D. C. Arc Systems will be published in October issue.

* * *

Visitors to the Toronto Exhibition, interested in structural work, may see an example of concrete and steel construction in the new warehouse of A. A. Allan & Co., Bay St., where the Kahn sheared steel bar is being used.

* * *

The Grand Trunk Railway, acting for all companies interested, has filed with the City Clerk of Toronto their plan for expropriation of the Esplanade property. The plan provides for the closing of Bay street, Lorne street, York street, from Front to Station street, Station street from Simcoe to York, and Esplanade street from York to Yonge street. The property to be expropriated includes all that west of the Customs House, and east of York Street, south of Front Street.

* * *

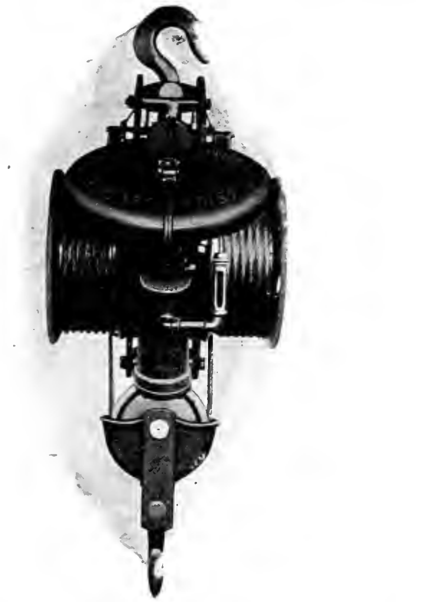
The largest wireless telegraph station in the world is being erected at Pisa, Italy. The station will be called Coltano, and it is designed to establish wireless telegraphic communication from there with Great Britain, Holland, the United States and Canada, as also with vessels in the Mediterranean, the Baltic Sea, the Red Sea and the Atlantic and Indian Oceans. The buildings will be of the most approved style, and will be constructed entirely of stone. As it will take some time to put the machinery and apparatus in place, the station will probably not be ready for receiving and transmitting messages before the beginning of next year. The Marconi system will be employed.

* * *

The Stromburg-Carlson Company, of Chicago, through A. B. Smith, has offered the city of Brantford $200 per year for a competitive franchise, to operate in Brantford, in addition to granting five free phones to civic officials. They promise to instal a central energy system before Christmas with immediate connection for 500 phones and an ultimate capacity of 2,000. All lines and cables will be underground, and the total outlay will be $35,000, borne entirely by the company. The proposed rates are $25 for business and $15 per year for house phones. The city will be allowed to string electric light and fire alarm wires on an arm of the company's poles. Long distance equipment has been arranged for between Brantford and Windsor. A representative of the Ontario Independent Telephone Co., of Detroit and Windsor, now operating in Western Ontario, made an offer on similar terms. The Stark Telephone Light and Power Co., of Toronto, is making four separate propositions to the city as follows: (1) Business phones, $6 per year and one cent per outgoing call, with a maximum charge of $25; residence connections, $6 per year and one cent per call for all calls, or a flat rate of $12 for unlimited service; electric light, eight cents per 1,000 watt hours. (2) Business phones at $25; residence phones, $15. (3) To construct an electric light and telephone plant on the Stark system at cost plus 10 per cent. engineering expenses, the city in addition to pay royalty of 10 per cent. of gross receipts for use of Stark patents. (4) To construct telephone system only at cost, plus 10 per cent. These propositions are now being considered by the council.

THE YALE & TOWNE ELECTRIC HOIST.

This hoist is designed to meet the growing demand for a simple, convenient and durable power hoist. It is made to withstand the roughest usage and give satisfactory service in the hands of the inexperienced workman. It may be moved from one place to another as easily as a chain block, and used in any part of the works or yards where current is available. It greatly increases the efficiency of any hand crane, and its compactness enables it to be hung up and operated in the smallest space. It is described by the manufacturers, the Yale & Towne Mfg.



Co., of New York, as follows: The material throughout its construction is the best obtainable, and all parts are made to gauge, thus securing complete interchangeability. The motor is placed above the oil submerged parts of the hoist and the motor shaft bearings prevent the possibility of oil entering the motor. The improved oiling devices preclude heating from overload, or injury from the high temperatures usually existing near the ceiling. The load is taken on wire hoisting rope of the toughest steel, wound on grooved drums that are keyed direct to the main shaft. At the bottom hook the steel hoisting rope passes around an equalizing sheave, thereby balancing the strain. All parts under tension or subjected to transverse strain are of forged steel or wrought iron. The hoist always balances properly on its single upper hook whether loaded or empty, and pulls in a true vertical line throughout the lift. The single swivel hook suspension allows the hoist to pull as well at any angle. The working parts are enclosed in an oil tight iron casing, which excludes the dust and water, at the same time insuring thorough lubrication. The load cannot run away even should the motor or brake become inoperative; an automatic cut off prevents the load being hoisted too high. The hoist is operated from the floor, and is regularly equipped with a telescoping controller rod enabling the workman to control it from a point in full view of his work without depending on signals to a crane operator. Pendant cords or chains will be furnished if preferred, but the rod-controlling device gives more accurate control of the load and is so made that it cannot catch any obstruction and start the hoist when traversing on a crane or runway.

The company have one of these hoists in operation at their exhibit at the World's Fair, St. Louis, where they have also one each of their triplex, duplex and differential blocks operated by electric motors for the purpose of showing relative efficiency. Each block is supplied with a 1,000-lb. weight and so arranged that equal power is supplied to each block. The result [illegible] block hits its load much more quickly than [illegible] the same time the ammeters show equal power [illegible] block. The mechanism is automatic, [illegible] triplex weight arrives at the top all three blocks reverse their motion and lower the weight until all rest on the floor, when they again automatically reverse and then hoist. The arrangement shows at a glance the comparative efficiencies of a block and is particularly interesting to any engineer.

BECKER-BRAINARD NO. 1, 14" CUTTER AND REAMER GRINDER.

This machine, which is made by the Becker-Brainard Milling Machine Co., of Hyde Park, Mass., is unlike other cutter grinders in that it requires no extra fixtures for handling any style of milling cutter or reamer. It has two separate knees each provided with its own slides. The cutter to be ground is transferred from one to the other for the different operations on the side and end teeth. Fig. 1 gives a view of the machine as regularly made from which we get a very good idea of the weight and proportion as a whole. Here we see the two different knees mentioned above. On the left-hand side of the machine we have the main knee, which swivels around the supporting column, and carries the head and tail stock for grinding cutters on centres, or with bar inserted in place of the head stock centre, and the tail stock removed. We grind cutters by sliding them on the bar in front of the wheel, which ensures a cutter ground straight and true with the hole. On the right-hand side we have a novel arrangement for grinding the end mills, or the side teeth

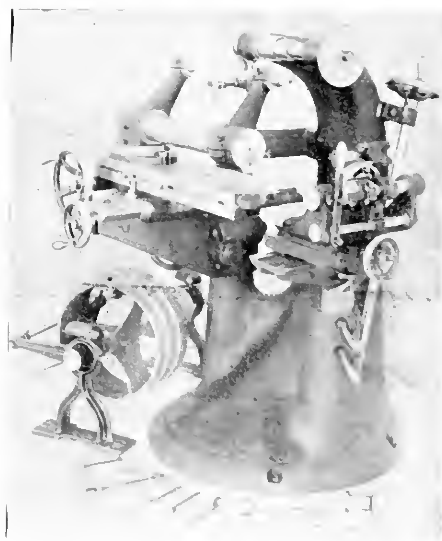


Fig. 1.—No. 1 Fourteen-inch Cutter and Reamer Grinder.

of straddle mills and inserted tooth cutters. This sliding head can be swivelled for grinding bevel or dove-tail mills, and is provided with a plunger finger which is always set on the centre. The object sought for in this arrangement is to do away with many of the devices ordinarily used for this work, and it is also unnecessary to use any other than 7 in. emery wheel shown. In Fig. 2 is shown a machine arranged with motor drive and which is on exhibition at Becker-Brainard Milling Machine Co.'s space in Machinery Hall at the Louisiana Purchase Exposition. Figs. 3 and 4 show good illustrations of the improved manner of handling work on the machine, showing as they do, straddle and end mill in both positions. This also shows how the clearance is obtained on the end and side teeth. Other illustrations, which cannot here be given for

lack of space, show a plain milling cutter on the bar and small end mill in the sliding head; a slitting saw on the bar and the sliding head swivelled with a bevel mill in position for grinding; a bevel mill in position for grinding between centres at the left-hand wheel; a large inserted tooth face mill in the sliding head, that is probably the most difficult cutter to handle on any grinder without using special fixtures. The sliding head arrangement on this machine makes this a very simple operation; and a

3 in mill

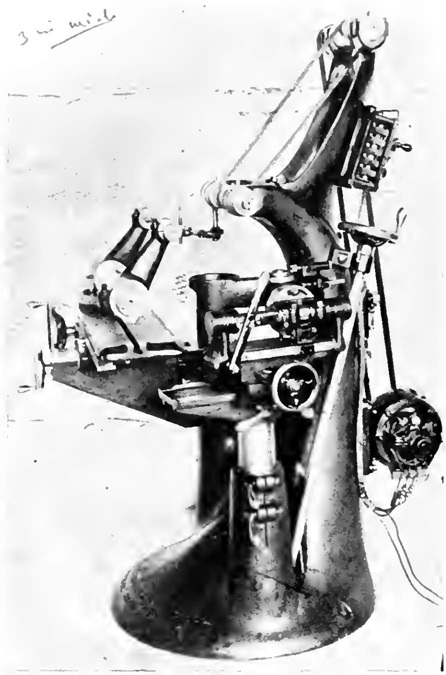


Fig. 2.—No. 1. Fourteen-inch Cutter and Reamer Grinder (Motor Drive).

large slab milling cutter on the bar in position for grinding. This machine has a capacity for all styles of cutters up to 14-in. diameter and 14-in. long. The machine is designed distinctively as a cutter and reamer grinder to fill the need of a machine capable of grinding heavy cutters of large diameter and long face, which are used on the large column and planer-type milling machines, also the large diameter inserted tooth cutters. The machine will take care of all styles and sizes of cutters, including

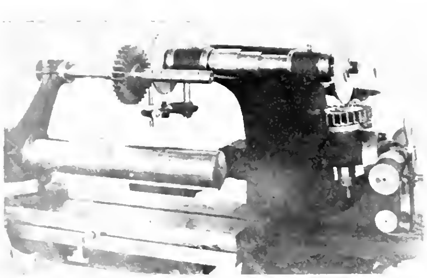


Fig. 3. Grinding Face and Side of Straddle Mills.

plain, straddle, form and end mills, being made especially stiff and heavy to eliminate vibration, which frequently occurs in most of the lighter grinders. The machine is provided with two columns, one of which has a knee, with saddle and table, which has 6-in. of vertical adjustment, and will swivel around the column in either direction. The adjustable vertical column is graduated so that setting can be instantly made to give the proper angle of clearance of cutter for different diameters of emery wheels used. The table on saddle is fed by rack and pinion, having a longitudinal feed of 20-in. and a cross feed of 7-in., and is provided with graduated swivel head, which carries a bar on which to slide cutters while being ground. Head and tail centres are also provided for holding end mills and reamers which have to be ground on centres. With the cutter grinders usually on the market, it is necessary in order to grind side, face and angular mills, to use

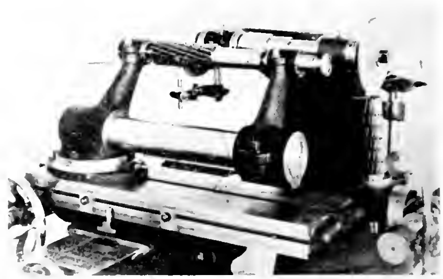


Fig. 4. Grinding Side and End of Taper Shank End and Side Mill.

special fixtures, which consume more or less time in setting, whereas with the machine described, it is unnecessary, as a second column is provided with swivel carriage carrying two cross slides, the top cross slide having 7-in. and lower slide 9-in. adjustment at right angles. On the top slide is mounted a graduated swivel head or holder, which slides on a bar, having a travel of 5-in. used for grinding the end teeth of cutters and end mills. The spindle is made of crucible steel and runs in self-centering bronze boxes, provided with wheel mounts fitted with taper end to always ensure perfectly true running wheels. With the machine, as described, cutters of all description can be ground without any change of fixtures, and much faster than the old methods of cutter grinding.

"MULTI-PATH" LIGHTNING ARRESTER.

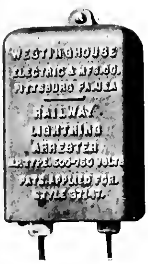
The unusual number of electric storms during the past summer in Canada makes the subject of lightning arresters one of interest. The necessity for the use of arresters for the protection of electrical apparatus is now generally recognized, and practically every plant now installed is provided with a greater or less number of arresters of one kind or another.

In order to understand the use and method of operation of a lightning arrester, it is well to consider the action of lightning or static electricity upon the transmission system. Take the case of a street railway system, where the trolley and feeder wires may be many miles in length. During a thunderstorm, or when the air is heavily charged with static electricity, a highly charged cloud passes over the trolley wire which is several feet above the ground and insulated from it. This highly charged cloud induces a charge of opposite side on the trolley and feed wires. There is, however, no tendency for the charge upon the wire to pass to ground, as it is "bound" or held by the charge in the cloud. If, however, the cloud passes away from the wire, or if the potential is suddenly lowered by a lightning discharge, then the charge on the trolley and feeder wires is no longer held and immediately tries to pass to ground. In order to get to ground, it may jump over a line insulator or pass through the insulation of apparatus connected to the trolley wire, i.e., motors, controllers or generators, or if there are lightning arresters connected to the trolley wire it may pass to earth through these arresters. It is evident, other things being equal, that the charge will pass over the path of least resistance. For this reason, it is necessary that the lightning arresters offer an easier path to earth for the lightning discharge than does the insulation of the appar-

atus to the circuit. If there were no voltage on the circuit other than the static voltage, a discharge, even through the insulation of the apparatus, might produce no serious consequences, but with a generator voltage constantly existing between line and ground, it is evident that a dynamo current may follow the static discharge and thus wreck the apparatus.

There are two essential requirements for an effective lightning arrester: 1. It must offer an easy path for static discharges to pass to earth. 2. It must not permit the line current to follow the static discharge through the arrester to such an extent as to damage the arrester.

To meet either of these requirements alone is a simple problem, for it is obvious that but for the danger of the line current following the static discharge a plain air gap



would be sufficient for making an effective arrester. On the other hand, if a low resistance path to earth was not demanded, the construction of an arrester, across which an arc would never be maintained by the line voltage, would be an easy matter. These two essential requirements are thus in a sense antagonistic, and the best that has been done is to make a compromise between them. Thus the path to earth has not often nearly so low a resistance to static discharges as could be desired, while every year hundreds of arresters are destroyed by their failure to interrupt the line current which follows the static discharge.

Many arresters now on the market use a carbon rod resistance in series with an air gap and an arc rupturing device. The function of the resistance is to limit the current which the line voltage can force through the arrester to a value such that it may be successfully interrupted by magnetic blow-out or other arc rupturing device. Unfortunately, the insertion of this carbon resistance increases the difficulty of a static discharge passing through the arrester. It is also found that on some arresters the resistance of the carbon rod increases enormously after a few discharges, so that current cannot pass through it, but is forced over its circuit. When this happens the speedy destruction of the arrester is certain.

During his extended investigations of static phenomena and the protection of apparatus from lightning discharges, it became evident to P. H. Thomas, of the Westinghouse Electric and Mfg. Co., that to successfully protect apparatus operated on low voltage circuits, such, for example, as railway motors and generators, it would be necessary to produce an arrester which would offer a much easier and more open discharge path to earth than could be found in any arrester previously devised. To protect the arrester from damage, due to the line voltage holding over, was also an essential requirement. Experiments were begun promptly, and have been carried on continuously for several years, both in laboratory and under actual service conditions. The result of these experiments has resulted in the production of an arrester which is said to have a protective power greater than that of any other.

Two general principles underlie the successful operation of the new arrester: 1. There is a minimum voltage, below which an arc cannot be maintained across an air gap, no matter how small that gap may be. 2. Under proper conditions, a static discharge will distribute itself over a great number of parallel paths, so that the amount passing over any one path will be very small producing practically no heating or disintegrating effect.

From this second principle the arrester takes its name Multi-Path (M.P.) The arrester consists essentially of a specially prepared block of carbon, in which the area offered for discharge is very great, as compared to the length of path through which the discharges pass. In this block there are a great number of separate conducting paths, and the discharge passing through the block divides and takes simultaneously many different ones. Each of these paths is broken up by a large number of minute air gaps, so that the voltage across each gap is very small and the line voltage cannot maintain an arc across them. Thus the arrester is non-arcing since the line current does not follow the static discharge. In series with the carbon is a small air gap rigidly maintained between two metal surfaces. This air gap keeps the arrester insulated from the line, except the instant of a discharge. The active parts of the arrester are enclosed in a cast-iron box which is filled with a waterproof compound. The arrester is weatherproof and fireproof. It may be used indoors or outdoors and may be located in practically any position desired. Its weight is from one-third to one-half that of any other arrester on the market, it is small and compact, and has absolutely no moving parts to stick and get out of order.

Some of the advantages claimed for the M.P. arrester are as follows: 1. Great protective power (low resistance to static discharges). 2. Non-arcing. 3. No moving parts. 4. Fireproof construction. 5. Light weight. 6. Neat appearance and ease of installation. 7. Simplicity and compactness.

A NEW PEAT PROCESS.

For ten years experiments have been made in Ontario and elsewhere with a view to converting bog peat into a practical commercial fuel. The usual method has been to compress the peat and set it in the sun to dry. This method has met with more or less success, but it has long been known that a certain amount of latent water remains in the peat. It is contained inside minute pods on the vegetable fibres, and these pods refuse to burst, but merely crowd closer together on the application of pressure. The result, of course, is that the peat has not as good burning qualities as it would if this latent water could be driven off, and besides that, the peat disintegrates after long standing, and the dust formed is waste, good for nothing but for use as a fertilizer.

A gentleman in England, however, who has been experimenting for a number of years, has at last found a method of driving off the latent water. His process is as follows: The peat is put in a perforated cylinder, which is revolved at 600 revolutions per minute, causing the loose water to be thrown off in all directions through the perforations. After the peat is brought to a moderately dry state, an electric current is passed through the peat in the cylinder and it is revolved again. Millions of sparks are thrown off, and also a great deal more water. The peat is then taken out and put through a brick machine, and after a couple of days' drying is ready for use.

The product is called peat coal, and tests show that it is better than anthracite, giving from 13,000 to 17,000 thermal units, as compared with 8,000 to 11,000 from the best English steam coal. The peat-coal is hard, clean, and without waste. It weighs somewhat heavier than coal. It is produced for 4s. a ton, and it is expected that this cost will be cut down to 2s. 6d. In the electric treatment the peat undergoes some change, which is not yet understood, which renders it practically smokeless. Such an invention as this was not long looking for a market. The Electro Peat-Coal Co. was formed, with Earl Meath as chairman of the board. A capital of £130,000 was asked for, and £160,000 was subscribed. The enterprise is the first successful industrial venture floated on the London market in three years. The company has a plant working on a commercial basis, and will establish plants all over the British Isles. The

German patent has been sold, and arrangements are being made for other European rights.

W. M. Barter, of Toronto, who has been interested in peat for a number of years, learned of the electro process when in England recently, and brought home the rights for America. The Mexican rights are being sold, and a Canadian syndicate has obtained the patent for Canada. An engineer is being sent to England to report on a demonstration, and if this is satisfactory a machine will be sent out immediately. Meantime the syndicate is securing peat beds at Galt and elsewhere. It is believed that the cost of production in Canada should not be more than a dollar per ton at the outside. The syndicate hope to have peat-coal on the market this autumn.

SCOTCH DESIGN OF VARIABLE SPEED LATHE.

We show herewith two illustrations of a new departure in lathe building by John Lang & Sons, Johnstone, Scotland, the special feature of which is the use of a variable speed drive instead of the usual step cone pulley.

The variable speed drive is of great benefit as a time-saver. For instance, suppose a round plate has to be faced across with an ordinary step cone lathe, the proper cutting speed cannot be evenly maintained right across, even if the operator shift his belt several times; with Lang's variable feed motion this is accomplished automatically, and, the hand wheel being connected to the cross-feed screw, the speed increases as the diameter of the job decreases, and maintains a constant surface speed at the cutting point as it approaches the centre, so the full value of the machine and the operator is got from circumference to centre without waste of time. The operation of the cones of this device is by the hand wheel in front of and near the right hand end of the fixed headstock. The turning of this hand-wheel also operates an index, seen projecting through a slot in both illustrations, which index moves along a graduated scale marked in diameter of the work, and the setting of the index to any graduation ensures a speed of thirty feet per minute for work of the diameter indicated, enabling the workman to see at a glance if the speed of the tool is correct for the work.

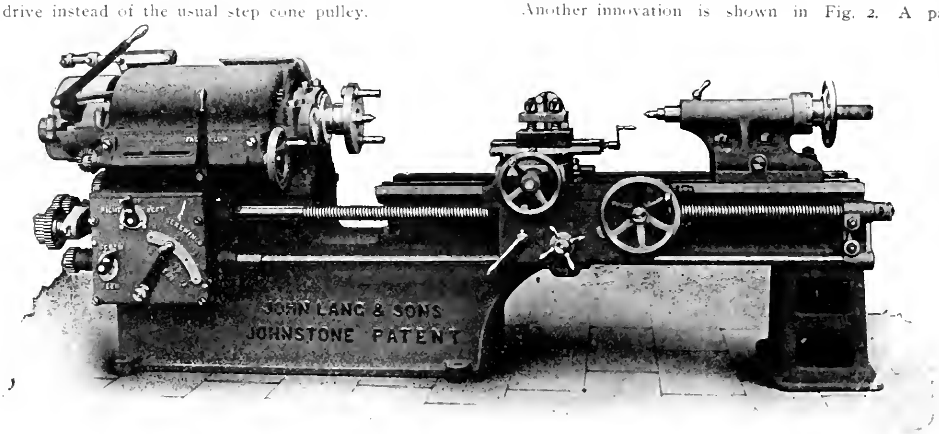


Fig. 1.—Twenty-inch Swing Triple-Geared Lathe.

Fig. 1 shows a 20-inch swing triple-geared lathe, and Fig. 2 shows a view, in plan, of a turret lathe with the gear removed. No counter shaft is necessary with this arrangement, the fast and loose pulleys being placed on the first shaft of the lathe, and are operated by the lever in front as shown on Fig. 2.

Another innovation is shown in Fig. 2. A pair of covers are fitted over the slide surfaces of the lathe bed. These are bolted to the bed, and pass through cored holes in the slide rest, their object being to protect the surfaces from falling chips and cuttings.

These lathes are made from new designs and patterns throughout, and combine the handiness of the American

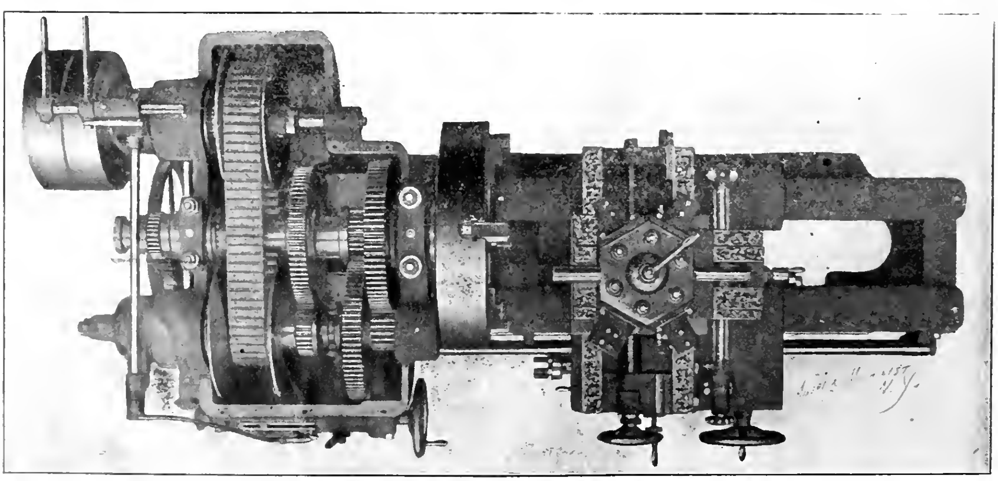


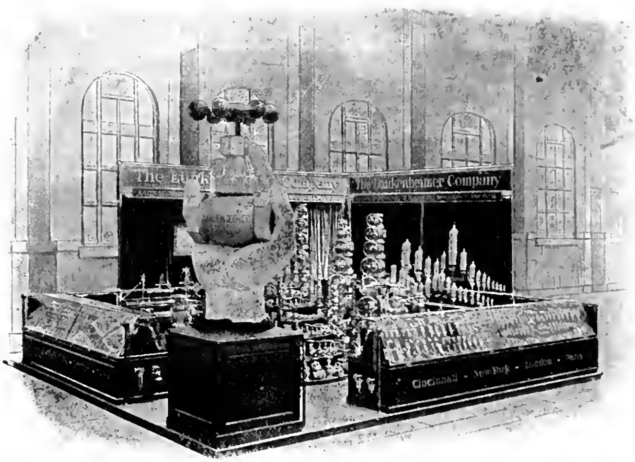
Fig. 2.—Turret Lathe without Gear.

lathe with the well-known solidity and finish of the British article, and enable the user to take the full value out of the new air-hardening, high-speed tool steel.

Mr. John T. Webster, 109 Niagara Street, Toronto, is Canadian agent, and invites enquiries from those interested.

THE LUNKENHEIMER EXHIBIT AT ST. LOUIS.

In Machinery Hall, Location 5G, Block 26, is the unique exhibit of the Lunkenheimer Company. It is easily identified by a large model of their familiar Valve in Hand, which occupies a prominent corner of their exhibit, as shown by cut. Pyramids of globe, angle, cross, lever and gate valves, of various designs and sizes, both brass and iron, are artistically arranged about the exhibit, and are agreeably off-set by a black plush curtain at the side and rear. The glass cases arranged in front of the exhibit contain a smaller class of the goods manufactured by them,



such as lubricators, oil and grease cups, cocks, etc., of all sizes. Neat designs of racks containing various sizes of whistles, injectors, pop valves and a variety of other specialties, help to make up an exhibit worthy of notice. A new design of water gauge and an oil-pump for cylinder lubrication are features in themselves. Pipe fittings of every description, safety and check valves and numerous other appliances are found in the exhibit.

The large variety of steam goods exhibited by the Lunkenheimer Co., and manufactured by them, necessitates more than a casual glance to thoroughly appreciate the exhibit in all its details.

POSTAL PNEUMATIC TUBE SYSTEM FOR CANADA.

The pneumatic postal service is rapidly coming into use in the United States. Several systems have been in use for some years in the large cities, notably New York, Chicago, Boston, Philadelphia, and St. Louis, the tubes being mostly 8-in. smooth bore with some 10-in. In Germany, the system has also been started, and the latest reports from England are that 12-in. tube system, in the City of London, is to be installed.

In Canada, Sir Wm. Mulock has taken the initiative and decided to adopt a 10-in. tube system, beginning first in Montreal and Toronto.

The system consists in forcing a current of air through the pipe at a low pressure, giving speed to the carriers which contain the letters and small parcels of 20 to 30 miles per hour.

This air current is obtained by power compressing plant at the station buildings, while the transmitting and receiving apparatus and machinery at the terminals become the points of inlets and outlets for the mail matter.

The tubes are ordinary cast iron bell and spigot pattern, bored smooth inside and jointed as usual with lead, when laid in trenches on the roadways.

The carriers for mail matter consist of light, circular steel sheets with external packing rings at each end to slide along the smooth interior of tubes. The turns at streets are made by suitable bends of large radii and slightly greater bore to allow the straight carrier to slide along.

The Canadian Government have placed the work in the hands of John Galt, C.E., M.E., of Toronto. The 10-in. tubing is supposed to be larger than really necessary for the present Canadian experiments, but the wisdom of adopting this size will be recognized when it is considered that the life of these under ground will at least be half a century, and by that time they may even prove slightly on the small side.

The extra cost involved over the 8-in. is only slight, and there are other advantages in operating this size, which practically make the system of no greater annual charge. It has also been decided to lay simultaneously a double or quadruple clay conduit pipe alongside and underneath the tube, so that connection can easily be made with electric wires for telephone, light or power between the various stations. This can be done at a trifling cost when tubes are being laid, and should prove a wise and independent provision to make.

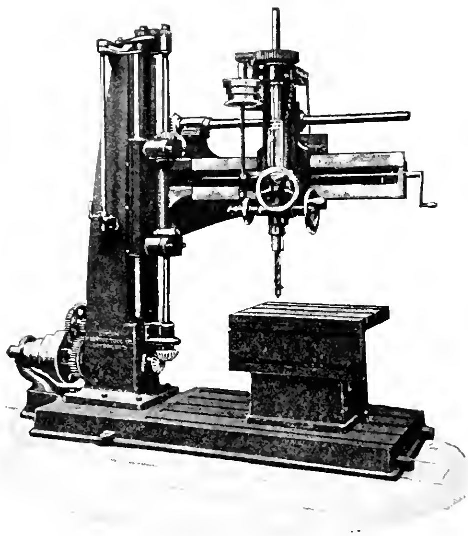
We understand, Sir Wm. Mulock has decided to at once call for tenders for all the straight cast iron, smooth bored piping, to be delivered in Montreal and Toronto next May, and by that time the question of location for main post office building contiguous to railway depot should be settled.

St. John, N.B., is buying two chemical fire engines from the American-La France Fire Engine Co., for $5,050.

City Engineer Barbour, of St. John, N.B., urges the adoption of a new city water system, bringing water from Loch Lomond. His report shows that less than $200,000 will procure for the city a high pressure and abundant supply.

NEW TYPE OF HORIZONTAL BORING MILL.

We herewith present a new type of horizontal boring mill, which has lately been put on the market. The capacity of the machine, as shown in the illustration, will bore up to five feet in diameter and six feet in length. The head is large and massive, having five speeds for four-inch belt, the largest diameter of cone being 23 inches, and being powerfully back geared gives ample power for the heaviest work, and permits of high speed steels being used to the best advantage. The boring bar is four inches in diameter, and has a feed of 36 inches without shifting the driving pins. The feeds are reversible, are eight in number, ranging in geometrical progression from 1-128 inches per revolution of spindle to 5-16 inches. This provides a variation suitable for any class of work. The feeds can be thrown in and out



while the machine is in operation from either side of the machine. Hand-feed and quick return is also provided. The table has movement, both crosswise and in a longitudinal direction. The knee is raised and lowered by power or by hand, as desired, the raising and lowering being accomplished by means of a worm and worm wheel placed underneath knee. A facing attachment with variable automatic feed is provided for facing up to 26 inches diameter. The total weight of the machine is 18,000 lbs. It is manufactured by the London Machine Tool Co., London, Ont., who will be pleased to furnish upon application any further information.

NEW INCORPORATIONS.

The Ontario Gazette announces the following incorporations:

The Silver King Gold and Copper Co., capital $2,000,000, head office at Toronto. Incorporators, H. L. Holmes and W. F. Bross, of Niagara Falls, N.Y.; W. H. Merrill and G. W. Morris, of Buffalo, and H. Denison, of Toronto.

The Fort William Contracting Co., capital $40,000. Provisional directors, C. W. Jarvis, A. Snelgrove and C. Beaton, all of Fort William.

Twin City Real Estate and Construction Co., capital $100,000, head office at Berlin. Incorporators, S. Brubacher, of Waterloo; J. Bingeman, J. H. Dudgeon, E. P. Clement and C. P. Hagedorn, of Berlin.

Canadian Talking Scale Co., capital $100,000, head office Toronto. Provisional directors, A. M. Macdonell, R. W. Ball and T. H. Barton, all of Toronto.

Dominion Cement-Brick Co., capital $50,000, head office at Toronto. Provisional directors, W. J. McMurtry, J. E. Webb, A. P. Ingrams, C. Nieuhaus, and J. D. Dobie, all of Toronto.

The Kamloops Lumber Co., incorporated under Dominion charter, has been licensed to do business in Ontario.

The Canadian Michigan Gold Mines, Limited, capital $1,000,000, headquarters at Sault Ste. Marie, the provisional directors to be W. Coyne, C. J. Brown and J. A. McPhail, of Sault Ste. Marie; E. S. B. Sutton and O. Supe, of Sault Ste. Marie, Mich., and others.

The Bertram Brake Co., capital $40,000, headquarters at Toronto, to manufacture car brakes. Provisional directors: C. J. Leonard, G. Gibson, C. Heath, F. Pole and C. S. Robertson, all of Toronto.

The Woodruff-Robins Co., capital $100,000, head office in Toronto, to be constructing engineers, architects and builders. Provisional directors: S. H. Woodruff and F. B. Robins, of Buffalo, and C. W. Winyard, J. Payne, and W. Gilchrist, of Toronto.

Ontario Crude Oil Co., capital $300,000, head office at Toronto. Provisional directors: J. W. Stokes, of Sarnia, and W. D. Earngey and J. Kynoch, of Toronto.

Orangeville Furniture Co., capital $60,000. Provisional directors: R. J. Disney, C. Hertel and others, of Hanover, and C. R. McKeown, of Orangeville.

Typograph Limited, capital $80,000, head office at Windsor, to make machinery for manufacturing light, heat, power, etc. Provisional directors: J. B. Allen, of Detroit; F. H. McPherson and S. B. Best, of Windsor.

Southern Light and Power Co., capital $300,000, head office in Toronto. Provisional directors: F. J. A. Davidson, C. A. Stone, and D. A. Dixon, all of Toronto.

Alpena Oil and Gas Co., capital $100,000, head office at Chatham. Provisional directors: S. T. Bell and S. Eagle, of Alpena, Mich.; T. Robinson, of Romney Township, and J. Rutherford and R. L. Gosnell, of Blenheim.

Dominion Roller Screen Co., capital $150,000, head office at Toronto. Provisional directors: F. A. Mansell, E. Sheetz, J. N. Lynde, C. T. Rodman and W. J. Coutts.

Goderich Cement Brick Co., capital $40,000, head office in Goderich. Provisional directors: G. Acheson, J. Clark, J. A. McIntosh, and others.

Stratford Chair Co., capital $60,000, head office in Stratford. Provisional directors: W. H. Crowe, A. J. McPherson, F. A. Nichols, and others.

The Canada Cork Co. has been incorporated with a capital of $500,000 to take over the business of the Canada Crown Cork and Seal Co., Toronto.

Geo. S. Sinclair & Sons, of Wiarton, iron founders, have been incorporated with a capital of $40,000.

The Lakefield Canoe Building and Manufacturing Co. has been incorporated at Lakefield with a capital of $40,000.

The Eldorado Mining Co., of Arizona, is licensed to do business in Ontario to the extent of $50,000 capital.

The Aylmer Iron Works Co. has increased its stock from $30,000 to $70,000.

The Barrie Carriage Co. has increased its stock from $40,000 to $100,000.

The following have been incorporated in Quebec:

La Compagnie d'Eclairage de Saint Georges, capital $150,000, headquarters at the parish of Saint Georges, Beauce, to produce electricity, furnish light, heat and motive power. The charter members are: G. Cloutier, G. Lamelin, J. J. Lavoie, J. Gilbert, O. Genest, all of the parish of Saint Georges.

La Compagnie de Telephone de Portneuf, with a capital of $10,000. The charter members are: J. G. McCrea, A. Lambert, P. Dolbec, J. E. Lebœuf, H. Grandbois, A. E. Grandbois, J. Giroux, N. E. Lacourciere, and others, of St. Casimir and adjacent places.

La Compagnie Electrique de la Baie des Ha! Ha!, with capital of $18,000, headquarters at the town of Chicoutimi, to produce and supply electricity and instal waterworks on

Grande Baie River. The charter members are A. Tremblay, of Hebertville Station, and others.

Dominion charters have been granted to:

The St. Lawrence Construction Co., capital $20,000, headquarters at Montreal, to buy and sell immoveable property or land. The charter members are: J. Ethier, A. Dansereau, A. Lecompte, H. Audette, of Montreal, and O. Dufresne, of Maisonneuve.

MECHANICAL WOOD PULP.*

By Stanislas Gagne, B.A., Sc.

(Continued from last issue.)

Wet Machines.

Theoretically, when the pulp has been screened, the mechanical process of extracting and preparing fibres from wood is ended, and the product is ready for the paper mill This is actually the case when the pulp is employed immediately for the production of paper or cardboard, which some of our Canadian mills manufacture, but the large bulk is produced for exportation, and, therefore, has to be put into convenient form for handling and shipping. The wet machines are used to extract the pulp from the water, which holds it in suspension, and to turn it into sheet form containing a conveniently low percentage of water. Figures 32 and 33 are cuts of the types mostly used in Canada, and Figure 37 illustrates the principle on which they work. First, there is a vat A, into which the pulp is admitted from the screen trough; the cylinder B, partly submerged, is a frame work covered with very closely woven brass wire cloth, which allows the water to pass through while the pulp it contains adheres to its outside surface, the couch roll C presses the felt D against the cylinder B, causing it to take up all the pulp adhering to the cylinder, leaving the wire cloth comparatively clean; the loaded felt then passes over roller E, which guides its direction over suction box F, which draws out part of the water in the pulp through the felt, over roller G, and between the press rolls H and K; the latter press out part of the water, and the pulp gathers around the upper roll H. The felt, now unloaded, passes over stretch roll L, over roll M, is beaten by beater N, washed by sprinkler P, passes over guiding rolls O and R, between the rolls S and T, which press out the water it contains, over roll V, and again over cylinder B, taking a fresh load of pulp, and so forth, continuously.

The vat A is made of ordinary pine, is water tight, and provided with outlet pipes, etc. The cylinder cloth must be of very fine construction, so that no pulp will pass through the meshes nor adhere to it too strongly; the ends of the cloth should be sewn together and not soldered, as it is sometimes done, because, at such a soldered connection water will not pass through; hence, no pulp will adhere to that part of the cylinder, and a gash across the sheet of pulp will result with each revolution, thus decreasing the capacity of the machine. The couch roll C is usually made of cast iron, and covered over with soft India rubber, which facilitates the removal of the pulp from the cylinder B by the felt. The felt D is usually about 20 feet long and 72 inches wide, and is woven in a continuous, endless form, of the best wool; grey ones made of Canadian wool are well adapted for the work, and give as good if not a better service than any. Most of the rolls are made of wood with the exception of the roll K. Much care is taken that the collecting roll H, which is formed from a solid piece of hardwood, is made perfectly true and is never allowed to dry, so that the surface will not be cracked nor split. The suction box is covered with a perforated plate, and as the felt passes over, the water is sucked down. Some advocate that the suction box should be connected with the draft tubes of the turbines, instead of suction pumps, but the disturbance and loss of power thereby caused exceeds that involved in the operation of pumps. Many mills prefer doing without suction boxes on the wet machines, leaving the work of driving out the water from the pulp partly to the press rolls and partly to the hydraulic presses; they claim that suction boxes wear out the felts much quicker, which seems to me reasonable, and it is a question whether they produce a drier pulp. The press rolls are tightened together by means of a spring and hand wheel at both ends of the collecting roll H, as seen in Figure 33, except in the case of that newly designed by the Jenckes Machine Co., of Sherbrooke, Que., where water pressure cylinders connected to lever arms at both sides of the machine do the work. This plan insures a more evenly distributed pressure between the two rolls, and thereby a more uniform sheet. When a sufficient thickness of separate sheets of pulp have gathered on the collecting roll H, the attendant cuts the sheet with a "doctor" or knife, as shown in cut 33, or by means of a pointed stick of hardwood, which he passes quickly across under the sheets. When the lower end is grasped and the roll allowed to complete its revolution, the sheet falls on the table in front of the machine, where it is folded and sent to the hydraulic presses. The guide rolls are made of wood, on which a certain thickness of cloth is nailed in a spiral form, and by means of a conveniently placed hand wheel can be moved by the attendant to one side or the other, thus keeping the travelling felt in a proper direction. The beater N is made of four arms attached to a revolving shaft, and together with water from the perforated pipe P cleans the felt from all impurities. The press rolls, S and T, are of

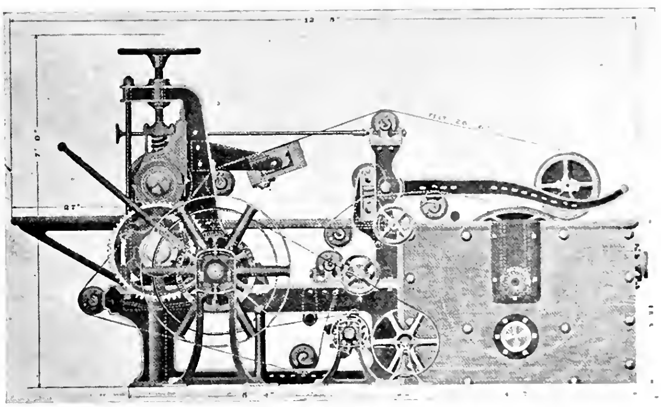
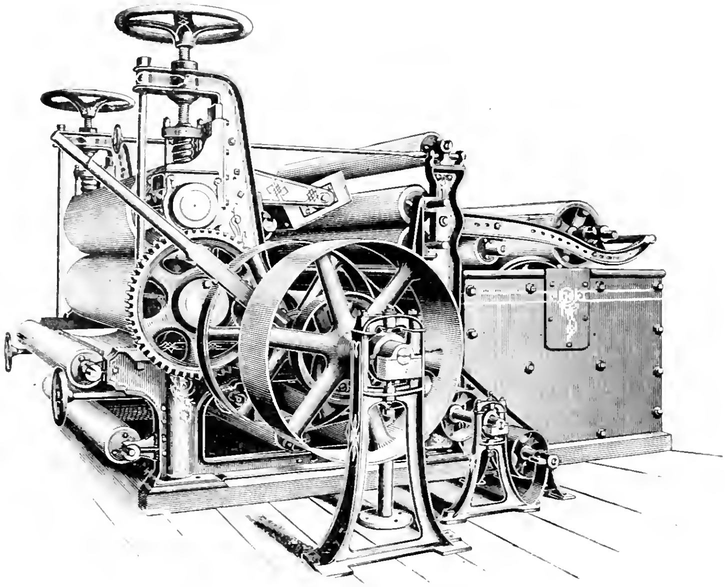


Fig. 32—Wet Machine, Waterous Engine Works Co.

*The above paper won the first prize given by the publishers of the Canadian Engineer for the best student's paper presented to the Canadian Society of Civil Engineers for 1903, the judges being members of the Society.

cast iron, and are pressed together by screws; they squeeze the water out of the felt before it takes a fresh load of pulp from the cylinder B. The frame of the machine is of ordinary cast iron. The capacity of an ordinary grey Canadian felt, 72 inches wide, is an average of five tons dry per 24 hours, with a speed of about 50 feet per minute; when new, it will carry more than when partly worn out. These felts last from four to eight weeks, according to the treatment they receive.



Wet Machine.

If resinous balsam is used, the capacity of the machine is much lowered, as the resultant clogging of the cylinder produces an irregular layer, which the gummed felt will not pick up entirely. The cleaning is done as in the case of the screens, by steam and coal oil.

Handling and Pressing.

The sheet of pulp from the press roll, usually ⅛ to 1-10 of an inch in thickness, is folded on the wet machine table so that there are no edges showing on the outside and ends, the final sheet being about 24 by 16 inches in size when a

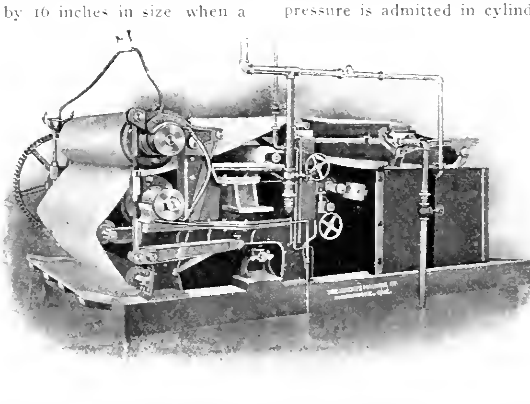


Fig. 33—Wet Machine (Jenckes Machine Co.).

which wet machine is employed. This pulp contains about 65 per cent. or so of water, depending on the use or disuse of a suction-box and on the pressure between the press rolls. As the cost of shipping such a combination of 65 per cent. of water and 35 per cent. of pulp would be uneconomical, and in most cases prohibited, the percentage of water is reduced by means of hydraulic presses.

After being folded the sheets are put on a truck specially constructed for that purpose, and between each one or two folded sheets such material as old felt or wire netting is inserted; the object of this is to facilitate the removal of the water when pressure is applied. Some mills use wire netting only, but if this is ungalvanized the pulp is liable to become spotted with rust, which much depreciates its value. Felt only will not serve the purpose quite as well as a combination of both felt and wire netting, in which case a piece of felt is inserted between each sheet and a piece of wire netting between two pieces of felt every three or four sheets. When the truck is loaded it is rolled to the presses.

This truck is constructed with such a distance between the wheels that when the ram or platen of the press rises it is borne up with its load of pulp, which is pressed without any injury to the truck, thus dispensing with unloading it. Figure 36 illustrates the principle of a hydraulic press very commonly used. The truck is driven over ram R, and water pressure is admitted in cylinder C through the opening and pipe D on piston E; the pulp sheets are pressed between ram R and top F by an amount depending on pressure admitted at D and on the size of piston E in cylinder C. The whole press is of very heavy construction, the lower frame of cast iron having a brass-lined cylinder, the piston and rod being made of steel, while the top piece and the platen are of cast iron; the top piece is supported and kept in place

by means of four heavy steel rods, with screw and nuts at both ends. (See Figure 42.) The pressure used is from 1,500 to 5,000 lbs. per square inch, and is supplied by triplex pressure pumps of usual design. In order to move the platen of the press more rapidly up before it starts to press and down after pressing, the cylinder is usually connected to a low pressure pump, or the discharge from the bottom of the cylinder may be let into the air, allowing the platen

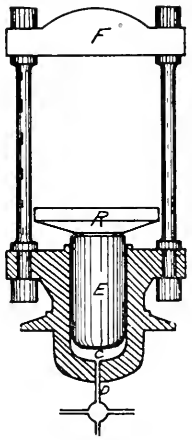


Fig. 36—Hydraulic Press.

to force the water out by its own weight. The percentage of water in the pulp after pressing is usually 50 per cent. This varies sometimes from 45 to 55 per cent., depending on the pressure applied and on the felting between the sheets, but not to any practical extent on whether a suction-box and very high pressure between press rolls have been

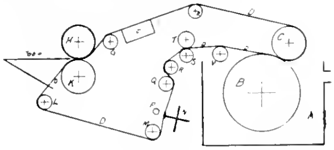


Fig. 37—Sectional Elevation of Wet Machine.

used in the wet machine. The object of the pressure is to get that percentage of water as low as possible, and their practical limit is reached when the pulp contains about 45 per cent. of water. To reduce this percentage other methods with heat as an agency must be employed; these will be considered later.

Baling.

After being pressed the pulp has to be baled into bundles suitable for shipment. From the presses the trucks are rolled to scales, where a sufficient number of sheets are weighed to form a standard uniform weight of dry or wet pulp. This standard weight or amount of pulp is then removed to a press. This consists of cast iron top and bottom, held together by four steel rods. The pressing is accomplished by means of two knees spread out or drawn in by a screw and sprocket wheel driven by a chain, and the driving is so arranged that when a certain pressure is applied the driving pulley falls out of gear and automatically stops pressing. When the pulp is placed in this press, two or three layers are laid under and on top of it, and while subjected to pressure the whole is tied by means of four or five wires inserted in grooves at the top of the bottom casting and at the bottom of the follower. Pressure is then relieved, and the bale is ready for shipment.

Sometimes a wrapper is used, but it is often found more expensive than the loss of pulp occurring without. If there is a chemical pulp mill in connection, a sheet made by this process will be tough, and answer the purpose very well, and at a small cost.

Tests.

There are two kinds of tests, for quality and for percentage of water. For testing the quality of the pulp at the mills the following methods are largely used. A glance at the sheet from the wet machine with a strong magnifying glass will tell the maker whether the pulp is too coarse or too short. Again, as the sheet, 1/8 or 1-10 of an inch thick, issues from the wet machine or from the hydraulic press a piece may be torn off and folded twice; if no cracks or splits appear after this operation the pulp is considered good. Again, a thin sheet when held to the light should not exhibit too large splinters or chips. There are many other such simple tests that may be made, and are employed by different manufacturers. The tests for determining the quantity of water in the pulp are performed by taking samples through different parts of the bales and weighing them

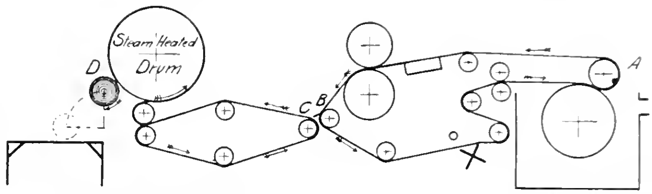


Fig. 38—Sectional Elevation of Dry Pulp Machine. From A to B is same as ordinary Wet Machine. From C to D is the Drying Part.

immediately, and then again after they have been dried by heat. The difference in weight gives the percentage of water in the pulp. This is a very delicate operation, one which requires skill and judgment. The percentage of water in a bale differs at various parts throughout the bale, being, immediately after pressing, greater at the edges than in the centre. The percentage also varies constantly from the time the bale is pressed until it is used at the paper mill, due to the drying up of the sides. The weight also changes from loss of pulp in manipulation and handling. These variations, which are the cause of constant disagreements between purchaser and seller, have originated a movement at present towards standardizing methods of testing. The most satisfactory method of determining a weight agreeable to both purchaser and seller is for both parties to determine the percentage of water in the bales when it is most uniform, i.e., just as it issues from hydraulic press.

Yield.

As mentioned before, this mechanical process transforms into pulp practically all the solid substances of the wood except the bark, the only loss occurring in the splinters that pass through unground or which are too large to pass through the screen holes. A cord of green spruce weighing 4,400 lbs. will weigh about 3,700 lbs. after being barked. This will produce on the average 1,000 lbs., or 51 per cent. of the weight of the green wood, the remaining 49 per cent. being water in the wood and the waste occurring through the process. Such a cord of wood treated by the soda or sulphite process would yield from 1,100 to 1,300 lbs. of dry pulp.

(To be continued.)

At a recent meeting of the directors of the Quebec Central Railway, held in London, England, Frank Grundy, general manager, was elected vice-president of the company. Mr. Grundy has been manager of the road for fifteen years. He was earlier with the Manchester, Sheffield and Lincolnshire Railway.

At the meeting of Toronto No. 1, C.A.S.E., at their hall on Victoria Street, August 3rd, W. J. Webb, who is about to leave Toronto for Winnipeg, and who has been financial secretary of the Association for several years, was presented with a very handsome gold Albert chain, with locket, suitably engraved. The presentation was made by H. E. Terry, president of the Executive, who made a few suitable remarks, and, while Bro. Webb was taken entirely by surprise, he made a neat reply.

UNIVERSAL WIRING TABLE.

Arthur R. Roe, in American Machinist.

In arranging the accompanying table, advantage has been taken of the fact that in the B. & S. gauge, wires from 0000 to 6 have ten times the cross-sectional area of wires from 7 to 16. For instance, No. 1 has an area of 83,694 circular mils and No. 11 has 8,234 mils; No. 4 has an area of 41,742 circular mils, and No. 14, 4,106 circular mils. So, whatever current No. 1 or No. 4 will carry at a given "drop," No. 11 or No. 14 will carry respectively one-tenth of that current with the same drop.

In the table the large figures in the two upper horizontal rows give the sizes in B. & S. gauge, the sizes from No. 0000 to No. 6 occupying the upper row, and the sizes from No. 7 to No. 16 the lower row, each size in the lower row being one-tenth the area of the size immediately above it. The small figures in these rows give the carrying capacity in amperes of the wire size in which column they are found, the upper figure giving the amperes required for a density of 1,000 amperes per square inch, the small figure immediately below the gauge number giving the maximum amperes for rubber-covered wire, and the lowest small figure the maximum amperes for weather-proof wire, both according to the National Electrical Code. The numbers in the body of each table give the load in ampere-feet (ampere × distance or length of one wire), for the different wire sizes. The left-hand vertical column applies to the upper row of wires and the right-hand column to the lower row.

The table becomes universal by applying any multiple or sub-multiple of 10. For example, at one volt loss No. 0000 wire has a capacity of 9,842 ampere-feet, and at 0.1 volt loss the capacity is 9,842 ampere-feet. Similarly, at 10 volts loss the capacity is 98,418 ampere-feet, and at 100 volts it is, of course, increased tenfold.

drop and wire size that correspond to any given number of ampere-feet. For example, if the ampere-feet should be 9,500, the table shows that No. 0000 wire will carry this load at 1-volt drop, No. 000 at 1¼ volts drop, No. 0 at 2 volts drop, No. 1 at 2½ volts drop, No. 3 at 4 volts drop, and so on. To illustrate the use of the table more explicitly, suppose it is desired to deliver 10 amperes over a line 700 feet long with a loss of 3 volts. The ampere-feet will be 10 × 700 = 7,000. Referring to the 3-volt line of the table, taking the 3 volts in the left-hand edge column, the nearest number to this is 7,344 ampere-feet, and at the head of the column in which this number is located are Nos. 3 and 13. As the left-hand "drop" column applies only to the upper row of figures, the size of wire to be taken would be No. 3. If the drop had been 30 volts instead of 3, then No. 13 would have been the proper size of wire.

Again, suppose that it were desired to deliver 15 amperes over a distance of 600 feet with a drop of 15 volts. The ampere-feet would be 15 × 600 = 9,000, and tracing into the table from 15 volts in the right-hand column, the nearest number is 9,284; at the head of this column are Nos. 00 and 9, and as the right-hand "drop" column was used, No. 9 is the proper size of wire.

Volts Loss Nos. 0000 to 6 Wire.											Volts Loss Nos. 7 to 16 Wire.
	211,600	167,805	133,079	105,592	83,694	66,373	52,633	41,742	33,102	26,250	
	167	132	105	82	66	52	41	34	26	21	
	0000	**000**	**00**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	
	210	177	150	127	107	90	76	65	54	46	
	312	262	220	185	156	131	110	92	77	65	
	20,816	16,508	13,094	10,381	8224	6529	5178	4106	3256	2582	
	16	13	10	8	6.5	5	4	3	2.5	2	
	7	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	
	39	33	28	24	20	17	14	12	9	6	
	55	46	37	32	27	23	19	16	12	[illegible]	
¼	2460	1951	1547	1228	973	772	612	485	385	305	2½
½	4921	3902	3095	2455	1946	1543	1224	971	770	610	5
¾	7381	5853	4642	3683	2919	2315	1836	1456	1155	916	7½
1	9842	7805	6190	4911	3893	3087	2448	1941	1539	1221	10
1¼	12,302	9756	7737	6139	4866	3859	3060	2427	1924	1536	12½
1½	14,763	11.707	9284	7367	5839	4631	3672	2912	2309	1831	15
1¾	17,223	13,658	10,832	8594	6812	5402	4284	3397	2694	2136	17½
2	19,683	15,609	12,379	9822	7785	6174	4896	3883	3079	2442	20
2¼	22,143	17,561	13,927	11,050	8759	6946	5508	4369	3464	2747	22½
2½	24,604	19,512	15,474	12,278	9732	7718	6120	4854	3849	3052	25
2¾	27,065	21,463	17,022.	13,506	10,705	8490	6732	5339	4234	3357	27½
3	29,525	23,414	18,569	14,733	11,678	9261	7344	5825	4619	3663	30
3¼	31,986	25,365	20,117	15,961	12,651	10,033	7956	6310	5004	3968	32½
3½	34,446	27,317	21,664	17,189	13,625	10,805	8568	6795	5388	4273	35
3¾	36,907	29,268	23,211	18,417	14,598	11,577	9180	7281	5773	4578	37½
4	39,367	31,219	24,759	19,645	15,571	12,349	9792	7766	6158	4884	40
4¼	41,827	33,170	26,306	20,872	16,544	13,120	10,404	8251	6543	5189	42½
4½	44,288	35,121	27,854	22,100	17,517	13,892	11,016	8737	6928	5494	45
4¾	46,748	37,073	29,401	23,328	18,491	14,664	11,628	9222	7313	5799	47½
5	49,209	39,024	30,949	24,556	19,464	15,436	12,240	9708	7698	6105	50
5¼	51,669	40,975	32,496	25,784	20,437	16,208	12,852	10,193	8083	6410	52½
5½	54,130	42,926	34,044	27,011	21,410	16,979	13,464	10,679	8468	6715	55
5¾	56,590	44,877	35,591	28,239	22,383	17,751	14,076	11,164	8853	7020	57½
6	59,051	46,829	37,139	29,467	23,357	18,523	14,688	11,649	9237	7326	60
6¼	61,511	48,780	38,696	30,695	24,330	19,295	15,300	12,135	9622	7631	62½
6½	63,972	50,731	40,233	31,929	25,303	20,067	15,912	12,620	10,007	7936	65
6¾	66,432	52,682	41,781	33,156	26,276	20,838	16,524	13,105	10,392	8241	67½
7	68,892	54,633	43,328	34,378	27,249	21,610	17,136	13,591	10,777	8547	70
7¼	71,353	56,585	44,876	35,606	28,223	22,382	17,748	14,076	11,162	8852	72½
7½	73,813	58,536	46,423	36,834	29,196	23,154	18,360	14,562	11,547	9157	75
7¾	76,274	60,487	47,971	38,062	30,169	23,926	18,972	15,047	11,932	9462	77½
8	78,734	62,438	49,518	39,289	31,142	24,697	19,584	15,533	12,317	9768	80
8¼	81,195	64,390	51,066	40,517	32,115	25,469	20,196	16,018	12,702	10,073	82½
8½	83,655	66,341	52,613	41,745	33,089	26,241	20,808	16,503	13,086	10,378	85
8¾	86,116	68,292	54,160	42,973	34,062	27,013	21,420	16,990	13,471	10,683	87½
9	88,576	70,243	55,708	44,201	35,035	27,785	22,032	17,472	13,856	10,989	90
9¼	91,036	72,194	57,255	45,428	36,008	28,556	22,644	17,959	14,241	11,294	92½
9½	93,497	74,145	58,803	46,656	36,981	29,328	23,256	18,445	14,626	11,599	95
9¾	95,957	76,097	60,350	47,884	37,955	30,100	23,868	18,930	15,011	11,904	97½
10	98,418	78,048	61,898	49,112	38,928	30,872	24,480	19,416	15,396	12,210	100

In order to use the table it is only necessary to multiply the single distance in feet (the length of one wire) by the load in amperes. As above stated, the product is ampere-feet, and the table shows all the combinations of

RODERICK McCALL, PROVINCIAL ENGINEER OF NOVA SCOTIA.

Dr. Martin Murphy, C.E., Provincial Engineer of Nova Scotia, after a service of a quarter of a century, has retired, and is succeeded by Roderick McCall. Mr. McCall is about thirty-five years old, and was born at New Glasgow, N.S. He was educated at the High School in that town, at Pictou Academy, and at the Royal Military College, from which college he graduated at the age of nineteen. The class of that year numbered eighteen, and some of its members have already won distinction. All but six of these young Canadians accepted commissions in the Imperial service. Two of them—Capt. Hensley and Capt. Laurie—fell in the South

African war. Two others—Major Cartwright, R.E., and Lieut.-Col. Kirkpatrick, D.A.Q.M.G.—are now in the Halifax garrison, and a fifth is Sir Percy Girouard, the famous Canadian engineer who has distinguished himself in South Africa. After leaving college Mr. McCall went into railway work, and was employed on various provincial railway surveys. His first important work was in the construction of the C.P.R. short line through Maine, in which he was associated with his class-mate, Girouard. He was subsequently in charge of the Middleton end of the Nova Scotia Central Railway, and resigned that position to become

Roderick McCall, Provincial Engineer, Nova Scotia.

engineer for the New Glasgow Iron, Coal & Railway Company, now the Nova Scotia Steel & Coal Company. In 1890 he became Deputy Provincial Engineer, in which position he gave such satisfaction that in 1902 the duties of the Engineering Department were divided, and Mr. McCall was given entire charge of the roads and bridges of the Province, with the title of Assistant Provincial Engineer, while Dr. Murphy retained control of the railways. At the last session of the Legislature provision was made for the superannuation of Dr. Murphy with an annual allowance of $2,000, Mr. McCall's salary being $3,000. He has made a special study of bridge and highway construction. Last summer he made a tour of the Good Roads States of the Union, and investigated the methods there employed. The results of his investigations were embodied in a valuable report presented to the Legislature, and indirectly led to the appointment of C. C. Coutlee, C.E., of Aylmer, Quebec, as Good Roads Instructor for Nova Scotia. In addition to his valuable work in connection with the construction of bridges in this Province, he made a survey in 1890 for the proposed widening and deepening of St. George's Harbor, Bermuda, and in 1894 visited the New England States to report on the two-foot gauge railways in operation there.

AN EMERGENCY BRASS FURNACE.

While visiting a small repair shop and foundry recently, the writer saw a small brass furnace that was characteristic of the place. They started to build a furnace for using crude oil as fuel, but before the furnace was completed a hurry-up order came in for a heavy brass casting. There was not sufficient time to send to the nearest foundry, so a half-finished furnace was hurried into condition for a coal fire and charged. An air pipe for furnishing blast to the furnace had already been placed in position and the shell was simply placed over this and lined with fire brick, the fire was started and anthracite coal packed about the crucible. The blast was then turned on, and in an unusually short time the metal was ready to pour. The results were so satisfactory that all thought of further improvement was abandoned and the furnace is still in use as it was so hurriedly pressed into service. A description of the construction of the furnace may be of interest to others who require some device for melting small quantities of brass occasionally. Fig. 1 shows a section of the furnace. It consists of an outer shell A, lined with firebrick, as shown at C. The bottom of the furnace is all composed of firebrick. The cast iron cover F is provided with an iron handle G. The products of combustion escape through nicks cut on the edge of the brick work, as shown at H. Dimensions are shown on illustration. The blast is taken from a small centrifugal blower which supplies the blast for the forges

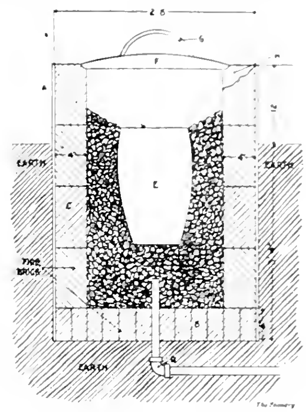


Fig. 1.—An Emergency Brass Furnace.

in the smith shop, and is introduced through a one and one-quarter-inch pipe, shown at G. This pipe extends about four inches above the bottom of the furnace. The fuel consists of anthracite coal of about grate-size. A bed of about 8 to 12 inches thick, depending upon the charge to be melted, is placed in the bottom of the furnace and the crucible E, set on top of it; coal is then filled in around the sides of the crucible up to the top, as shown. Fig. 2 shows

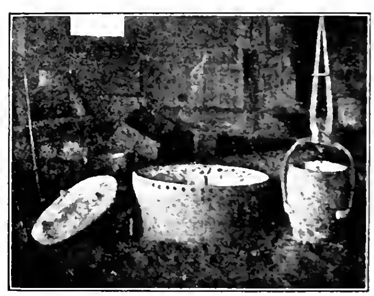


Fig. 2.—An Emergency Brass Furnace.

the general appearance of the furnace as installed in the shop. The crucible can be seen standing at the right and the cover at the left.

Charges of from 200 to 350 pounds can easily be melted in this furnace and by having a second crucible charged, ready for introduction into the furnace as soon as one is removed, it is possible to melt from three to four charges in succession. In the latter case the coal filled in about the first crucible falls down to form the bed for the succeeding one.—C. B. A. in Foundry.

—A party from the British Antarctic expedition ship Discovery penetrated to the 82nd degree in December, 1902. This is the most southern point ever reached.

—By arrangement with Brown, Boveri & Cie., electrical engineers, of Baden, Switzerland, the Crocker-Wheeler Co., of Ampere, N.J., have secured their alternating current designs, patents and rights to manufacture in America, and have retained them as consulting engineers.

AUTOMATIC CENTRE PUNCH.

The Brown & Sharpe Mfg. Co., of Providence, R.I., have brought out a new Automatic Centre Punch of entirely new design. It has features that make it much more convenient and accurate for laying out work to be machined or drilled than the ordinary centre punch and hammer. It combines lightness and simplicity with durability, and the various parts are proportioned to withstand the most severe usage to which a tool of this character should be subjected. All parts are of steel and those parts most subject to wear are carefully hardened. The tool is self-contained, the striking mechanism being enclosed in the knurled handle, which is of such a size and form as to be conveniently held in the hand. It is about 5¼-in. long and ⅝-in. diameter. When following a line or establishing a point by the intersection of lines, one hand can be free to guide the point or hold the magnifying glass, and, after the point is located, it is not apt to slip and lose the setting, as just a downward pressure of the handle releases the striking block and makes the impression. Another advantage appreciated by mechanics is that the punch marks are all of uniform depth, and, therefore, more easily and accurately followed than when of varying depths.

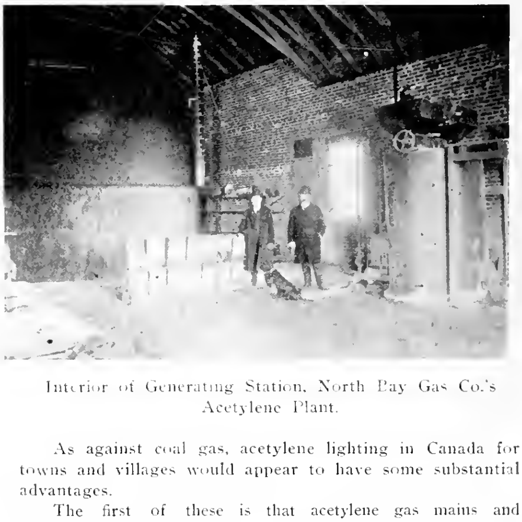
TOWN LIGHTING BY ACETYLENE.

Although the discoverer of the commercial production of acetylene gas from calcium carbide is a native of Canada, and this country figures largely in the manufacture of carbide, progress in the lighting of towns by acetylene gas has been more marked in other countries, notably in Europe, than here. Acetylene lighting has made more headway in Western Canada than in the eastern Provinces. Birtle, Carberry, Virden and Moosomin are lighted by acetylene and Souris, Deloraine and Gladstone are either equipped or are being equipped with acetylene plants. The tanks, or gas-holders, have in each case, we understand, a capacity of 3,000 cubic feet, and supply from one or two hundred up to several hundred lights. In each of these towns the system appears to give satisfaction, and the number of consumers is being steadily increased. Among Ontario towns that have adopted acetylene are North Bay, Bradford, Rodney, Aurora, Oshawa, Bolton and Milverton.

The largest, as well as one of the most successful, acetylene plants in Canada is that at North Bay, a town of between 4,000 and 5,000 inhabitants, at the junction of the Canadian Pacific Railway main line with the branch of the Grand Trunk connecting with Toronto. This plant is operated by the North Bay Gas Co., of which A. F. Leggatt is president and manager, A. G. Browning vice-president, and John Ferguson, Wm. Martin and S. and D. Purvis, the other directors. Construction on the plant was started in the autumn of 1902, but it was not put into operation till April, 1903, when it began with 180 lights. There was then in operation an electric lighting system, owned by another company, which had been in existence about twelve years, generating its electricity by steam. At the time the acetylene plant started, the electric system had about 1,500 lights, and is reported to have about 1,800 now. In the same time the acetylene plant has increased its services from 180 to 1,200, and is extending at the present time at the rate of 100 services a month. The gross income of the acetylene plant is now $4,000 a year, and it is claimed that the net profits of the plant are greater than that of the electric plant, which has a gross income of about $9,000. In the case of the acetylene plant the manager and one assistant do the entire work, and the supply of gas and of connections can be considerably enlarged without any increase of the staff. In fact, the same staff operates the plant now that was required when there were only one-fifth as many lights. The company expects to pay a dividend of 7 per cent. this year.

The gas tank holds 4,000 feet of gas, and at each fresh charge carbide is put in to make 1,000 feet. An interior view of the generating station is here shown, and this equipment is sufficient for 8,000 lights. The company paid $60 a ton for carbide till last year, when the price was increased to $65. To this freight has to be added, making it about $70 a ton. The company charges its customers $1.75 per 100 feet (equivalent to 1,000 feet coal gas), with a discount of 12½ per cent., making the net price $1.53, with no charge for meter, against a charge of 15 cents per 1,000 watts, with 25 cents per month for meter charged by the electric company. This makes the net price slightly in favor of acetylene for the same candle power of light. In practice, the advantage is still more in favor of acetylene for the lighting of stores, it is claimed, because there being no electric current on during the day, the consumer cannot use the electric light on dark days or in cellars. A half foot burner gives a 24-candle power light, which, with a simple installation, yields a good, strong illumination, the character of the light being a nearer approach to daylight. This appears to be a consideration with many merchants, especially dry goods dealers, and consequently most of the shop lighting in North Bay is now done by the acetylene plant. The C.P.R. station is also lighted with it.

A. F. Leggatt, President and Manager, North Bay Gas Co.



Interior of Generating Station, North Bay Gas Co.'s Acetylene Plant.

As against coal gas, acetylene lighting in Canada for towns and villages would appear to have some substantial advantages.

The first of these is that acetylene gas mains and service pipes need not be laid below the frost line. The troubles of last winter will be remembered by coal gas people as well as waterworks people; but in North Bay,

where the mains are laid only six inches below the surface, and in some cases actually exposed above ground, or placed immediately under the sidewalk, there was not a single case of freezing, though the thermometer registered 50 degrees below zero on one or two occasions. The mains were opened three times last winter to lay new connections, but the pipes were found to be "dry as punk," to use the words of the manager. This, of course, means a considerable saving in the cost of laying pipes, as well as in the convenience of taking them up or laying new connections. In laying the mains here a sheet iron "drip box," about 12 inches long and 6 or 8 inches deep, is, however, put in wherever there is a depression in the level of the main, which is led through the box near its top and provided with a cock to let off any condensation that may develop.

The second advantage for a small town is the smaller cost of installation. An acetylene plant for a town the size of North Bay will cost about $12,000, whereas the cost of a coal gas plant would be about $60,000.

The third advantage of acetylene is the small cost of maintenance, as before shown, and the relatively small cost of extensions, this difference applying not only to extensions at the generating stations, but extensions of main and service pipes.

The fourth advantage of acetylene over coal or water gas—and it is an important one—is that it is infinitely less poisonous. In 10 hours not more than about 5 feet of acetylene would pass through an ordinary burner, and if the peculiar smell of acetylene did not disclose itself to the occupant of a room it would at least fall short of fatal effects, whereas fifty feet of coal or water gas would pass through a burner in the same time, and the frequent items in the daily papers tell with what effect.

Fifth, naked acetylene lights do not flicker as coal gas lights do, and are therefore not so trying to the eyes.

Sixth, acetylene lights of corresponding power do not vitiate the air to the same degree as coal gas lights.

For the operator of the acetylene plant, as well as for the operator of the coal gas plant, there are by-products, as the refuse carbide affords a serviceable quality of slack-lime for plasterers' use and for fertilizing purposes, being sold for these purposes at $5 a ton.

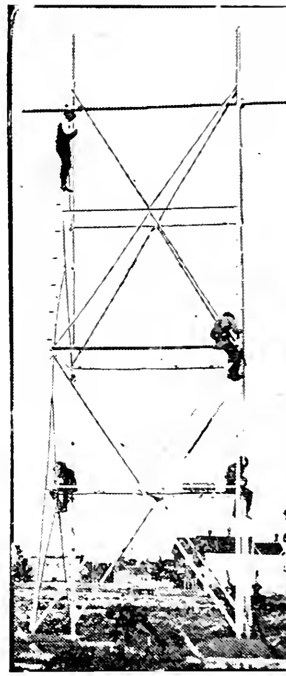
THE TORONTO NIAGARA POWER CO'S. TRANSMISSION LINE.

The transmission line which is to carry power from the generating station at Niagara Falls to the distributing station in Toronto is now under construction. The terminal station in the north-west of Toronto is being erected, and conduits are being laid from that point to sub-stations of customers of the company. Everything is being got ready for the advent of the "juice," which, it is expected, will reach the city in the course of a few months.

The transmission line is of interest, as it is the first of its kind in Canada. Experience with similar undertakings in Mexico and elsewhere is being put to service in the construction of the Canadian line, with adaptations to local conditions as necessary.

The right of way (the route of which was shown in a cut published in the June number of the Canadian Engineer) has an average width of eighty feet, and will be flanked by two lines of steel towers carrying the conductors. The line consists of four three-phase circuits, to be operated at 60,000 volts, two circuits being carried by each line of towers. The towers are constructed of galvanized steel angles bolted together with bracing similar to the usual design of windmill towers. They will be forty-six feet high, having a base fourteen feet by twelve feet. Lengthwise of the line each tower will have a uniform width of fourteen feet from bottom to top, but crosswise the width of twelve feet at the bottom will diminish, the sides coming together at the top. A steel pipe will form a cross-bar, carrying four steel pins, on which insulators will be placed. The other two insulators will be placed on vertical steel pipes, so that the conductors of each circuit form an equilateral triangle, with a horizontal base of six feet. The towers will be sunk about six feet in the ground, each foot resting on a cedar block, and braced with other blocks, upon which the earth will be solidly rammed. Wherever the nature of the soil demands it, a concrete foundation will be used. Towers will be bolted together in a horizontal position and raised to the vertical by means of a derrick.

The above is the description of the typical tower, which is designed to withstand a side strain of 10,000 pounds applied to the top. The towers will be spaced 400 feet apart, and about 1,200 of them will be used, a large part of which quantity is being furnished by the Canada Foundry Co. Where unusual conditions exist, special towers will be



Steel Tower used in transmission line of the Toronto & Niagara Power Co.

provided. At curves the towers will be placed at shorter intervals, and so constructed that they will be equal to the strain without guys. At the crossing of the Welland Canal towers will be erected of special height to allow the passage of ships below the conductors, and the same will be done at the Hamilton Bay Gap. With few exceptions the line passes through a practically level country and presents few difficulties in construction.

The insulators will be glazed brown porcelain, in three or four parts. The parts making up the insulator will be cemented together and the insulator cemented to the steel pin. The insulator will be about fourteen inches in diameter of top umbrella, and about fourteen inches high over all.

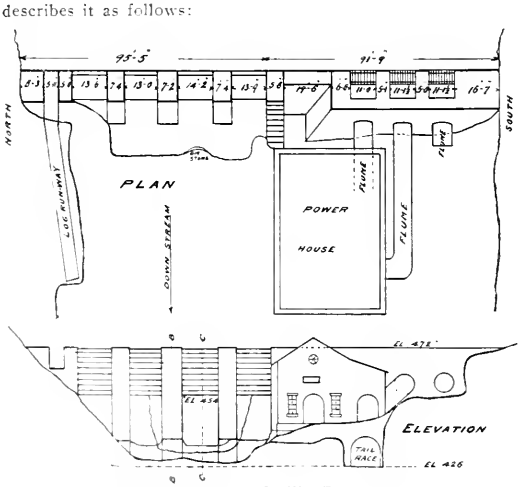
The conductor will be composed of six strands No. [illegible] copper wire wound about a hemp core. The combined area of the strands is 100,000 circular mills, and a high conductivity with a high tensile strength and elasticity is obtained. Tests with this cable show that an elastic limit exceeding 35,000 pounds per square inch can be obtained with an ultimate tensile strength of 55,000 pounds per square inch. The cable, which will be supplied by the manufacturer in lengths of 3,000 feet, will be joined by twisted copper sleeves unsoldered, and copper tie wires will be used. Low temperature, wind, sleet, etc., have been provided for in the spacing of the towers and the amount of sag to be allowed. Lightning arresters of ample capacity will be placed at various points on each circuit, each arrester being provided with a knife-switch for disconnecting it from the transmission line.

FAILURE OF THE ORILLIA DAM.

The dam from which power is generated for the town of Orillia is situated in a gorge of the Severn river, 19½ miles from the town. Before the dam was built, there was a fall in the river of about 35 feet at this point, where the banks are formed of granite rock. The construction of the dam was started in the autumn of 1898 by a firm of Buffalo contractors, but their progress was so slow that the work was taken out of their hands and given to another contractor, who appears to have expressed his doubts of the plans handed over to him, partly for the reason that the foundation of one side of the dam was not upon solid granite, but upon portions of the rock that had become disintegrated and reduced to a bed of sand. However, he took over the contract and completed the dam, but a considerable and essential portion of the work was carried out in the winter time and in running water, which, it is claimed, washed out the cement. The contractor denies this, and alleges that the break was caused by the washing out of the disintegrated rock at the bottom of one of the sections shown in the accompanying plans. The dam broke away on the 7th April last, during a period of high water, the break having commenced at the bottom, the concrete portion being first carried away and then two sections of the upper works, one after the other.

Orillia Power Dam.

The dam consisted of two sections, the total length being 185 ft., of which the power house and flumes took up 92 ft. and the spillway portion 93 ft. A correspondent of the Canadian Engineer, who visited the site after the break, describes it as follows:



Plan and Elevation, Orillia Power Dam.

"Portland cement concrete was used for the dam throughout, the stream bed and banks being rock. The south half, or power house portion, containing the gates and flumes were founded upon a ledge of solid rock at the elevation shown, which was well out of the way of the running stream. The north half, or spillway portion, consisting of two types of section, one of which we will call section B-B, running up to the top level of the dam, as a continuous concrete wall, or pier, the other as per section C-C, only to an elevation of 18 feet below the top of dam, and being supplemented by stop logs to bring it to high water level, sections C-C alternating in between sections B-B, as shown.

The area of the section B-B, at the position where it attains the greatest height of wall, viz., 46 feet is 970 sq. feet, which at 140 lbs. per cubic foot, will weigh 135,800 lbs.

The area of adjoining section C-C will equal 590 sq. feet, which at 140 lbs., will weigh 82,600 lbs.

Multiplying B-B by its length of 7 feet 2 inches, and C-C by its length of 14 feet 2 inches, we have 966,600 lbs. + 1,169,610 = 2,136,210 lbs.

Now the total pressure upon such surface, 21 feet 4 in., in length of a dam 46 feet in height, will equal 1,411,107 lbs., giving a co-efficient of friction of .660.

The overturning moment of the water pressure will, upon the length of 21 feet 4 inches, equal $1{,}411{,}107 \times \frac{46}{3} =$ 21,636,974 ft. lbs. The stability of the section will equal

$$
\begin{aligned}
966{,}600 \times 12 &= 11{,}599{,}200 \\
1{,}169{,}610 \times 14 &= 16{,}374{,}540 \\
\hline
&\ 27{,}973{,}740 \text{ ft. lbs.}
\end{aligned}
$$

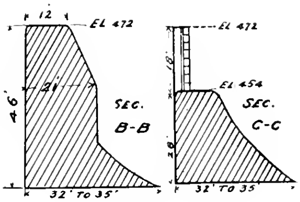
As the co-efficient of friction existing in the structure may possibly have been equal to .660, I will not say positively that the trouble lies here. As the stability moment of 28 millions exceeds the overturning moment of 22 millions, I cannot say that the trouble lies here. But one can quite readily see that the estimated pressure in each case is uncomfortably near to the estimated strength. The dotted line, shown on the elevation, represents the line of breakage, all of the wall above this line having been carried away.

It will be noticed that the break occurred at the part where the greatest height and greatest pressure existed. It may also be pointed out that where the break occurred is also where the greatest difficulty was encountered in depositing the material, a portion of it having been deposited, I am informed, in still water, about six feet in depth, recourse having been had to the open cylinder method of depositing concrete. It is well known that this is not the most desirable method, one great drawback being that small chance is afforded for inspection of the bed of the stream. The bed of the stream at this point is known to have contained a deposit of sand, and loose stones, and it is inconceivable that material should have been put in place without every vestige of such deposit having been removed. It was noticed that when the river was in flood, the water "boiled" at the foot of the dam, but later on this point of boiling occurred some distance down stream, and it is asserted that an opening had occurred through the foot of the dam, underneath one of the sections C-C. As this opening, and the pressure of the stream through it, increased, the point of "boiling" occurred farther down stream, until suddenly one of the piers, B-B, fell outward, and northward, and the whole section, as shown, followed."

Another correspondent, who also visited the dam after the break, attributes the beginning of the trouble to the lack of cement in the concrete, and is of opinion that if the proportion of cement was put in, it was washed out by the running water, the current here being 10 to 15 miles per hour. He says a number of voids were visible in the concrete portion, and not more than half of these voids were filled up with mortar. As the break first occurred at the bottom, it was not a question of the "overturning moment. A fact to which the correspondent calls attention is that on one face of the section still standing a piece of one of the "forms" used in laying the concrete is to be seen, showing that the form had never been removed when the concreting was done, and that the presence of this form would prevent the bonding of the material—a possible cause in itself of the final break of the section.

It appears that the engineer who made the plans did not supervise the work of construction; and there seems to

have been little continuity of policy in the town council in dealing with the question, each councillor having his own plans, and most of them pulling at cross purposes. Three or four civil engineers were consulted, after the failure of the dam, and in the end the advice of none of them has been carried out. The construction of a tunnel through the rock at the gorge appeared to be favored as giving the surest ultimate results, but the first cost was a stumbling block to this plan. The council appears to have exercised little or no supervision while the work was being carried out, yet it spent $2,000 on preliminary work for a dam proposed by a local man which a few weeks after was rejected for another plan.



Sections of Dam.

The matter has been settled for the present by a contract signed on the 17th August, between the Mayor and clerk, on behalf of the town, and Joseph Battle, of Thorold, Ont., who has agreed to construct a wooden dam for $28,000 and have it ready by October 15th, 1904. Mr. Battle furnishes bonds of $10,000, good for two years, as a guarantee of the work. A penalty of $25 a day is to be paid if the work is not finished at the specified time.

Meantime, Peter Ryan, of Toronto, is trying to make a settlement of the Patriarche-Ryan suit against the town. It is hoped to clear up the whole business without another appeal to the courts.

RAILWAY NOTES.

The C.P.R. is re-tracking the main line from Toronto to London.

The Ottawa Car Co. is building five cars for New Glasgow, N.S.

The C.P.R. may buy the Berlin, Waterloo, Wellesley and Lake Huron Railway.

November 15th is the date set by Grand Trunk officials for the inauguration of the main line service through Brantford.

The Grand Trunk is building a freight shed, 30 by 150 feet, in Waterloo, and is adding seven sidings to the yard there.

The London Street Railway Co.'s car barns were destroyed by fire early in August. The loss is estimated approximately at $25,000.

The C.P.R. is establishing divisional statistical offices to compile weekly reports instead of the present monthly record made at Montreal. Toronto and Montreal are the first two such offices.

The Privy Council has reversed the decision of the Court of Appeal, in the case of Toronto Railway Co. vs. Toronto. It is held that cars are personal property and unassessable.

The Grand Trunk is about to put up a $60,000 roundhouse, in London, Ont. It will have 42 stalls and a turntable. Yarding facilities at London will probably be increased.

Traffic Manager Tiffin, of the Intercolonial, says a much better service will be put on the Canada-Eastern when it comes under Government control. The shops at Gibson will be retained.

A loaded freight train on the Quebec and Lake St. John Railway ran away, and was wrecked at Hedleyville, near Quebec. The loss to the company is estimated at $40,000. No lives were lost.

A contract has been entered into between the P[illegible] Department and Rhodes, Curry & Co., of Amherst, N.S., for the building of a new private railway car for the use of the Governor-General.

The Quebec and Lake St. John Railway directors are calling for tenders for the construction of thirty-eight miles of railway to connect the main line from Quebec with the St. Maurice line at La Tuque.

The first of the ten passenger locomotives which the Grand Trunk ordered from the Locomotive and Machine Company, of Montreal, Ltd., has been turned out. The locomotives are of the large ten-wheeled type.

The Intercolonial Railway has decided to build a new station at Sydney. It will be of stone and brick, and is to cost $70,000. Tenders have been called for and the station is to be completed early next summer.

The Quebec Electric Company, in the course of a few days, will start work on the installation of its plant at St. Anne and Seven Falls. It is the intention to operate an electric railway from Ste. Anne de Beaupre to Murray Bay.

The contract for carrying the British-Australian mails, which has been held by the C.P.R., has passed to the New York Central, Lake Shore, Northwestern, and Union Pacific. Recent Lake Shore improvements in roadbed and equipment effect a saving of time, and are credited with helping to obtain the contract.

A new railway is to be built from Rouse's Point, N.Y., to St. Constant, P.Q., where it will connect with both Grand Trunk and Canadian Pacific, considerably shortening the distance from Montreal to Rouse's Point. The line will be constructed by a private company. G. D. Dunne, of Ottawa, is preparing plans.

The Caraquet, N.B., Railway has been bought by Messrs. Peter Ryan and T. P. Coffee, of Toronto. It consists of eighty miles of track, running from Bathurst to Tracadie Mills, through a good, farming, fishing and lumbering country. The road was built about twenty years ago, and heretofore has been owned by the English bondholders.

The Grand Trunk Railway will shortly erect a series of new shops, at Stratford, at a cost of $170,000. At this point eight hundred men are at present employed by the company, and it is expected that by the end of the year that number will be increased to one thousand. The buildings are to be erected and the machinery installed by December 15th.

S. T. Callaway has been appointed manager of the Locomotive and Machine Company, of Montreal, Limited, succeeding Roger Miller. Mr. Callaway, is a son of the late S. R. Callaway, president of the company. George Gurry, a practical locomotive builder of large experience, is superintendent of the works at Longue Pointe. The company is spending a large sum of money in equipping the plant for turning out a large number of locomotives, and in providing homes for the skilled workmen.

F. S. Darling, the Canadian Pacific Railway engineer in charge of construction work east of Winnipeg, makes the following statement regarding the proposed Toronto-Sudbury branch: The line will cost $8,000,000, and of this amount $2,000,000 will be required for the 58 miles from Romford to Byng Inlet. The grade of the centre route shall in no place be more than three-tenths of 1 per cent. There will not be any curve higher than 4 per cent. This will make it equal to any section on any line in Canada. A large number of men are now at work on the portion of the line between Romford and Byng Inlet, where the rocky nature of the country makes it cost over $35,000 a mile. In addition, a large number of bridges will have to be constructed, the one at the French river alone to cost $300,000. Regarding a port on the Georgian Bay, the best location for one would be at Byng Inlet, for, though it is situated four miles from the bay, there is a straight channel. As soon as the first portion of the line is completed, the contracts for the second portion will be awarded. Though the northern portion of the territory is a wilderness, it contains splendid lumber, while the remainder is through very fertile country.

Trenton passed a by-law to provide $20,000 to purchase Ontario Electric Railway debentures.

Plans for the route of the Toronto and Hamilton Railway have been submitted to the railway department in Ottawa and approved.

Good progress is being made with the Canadian Northern extension from Carberry to Brandon. The line is within four miles of Brandon, which will be reached this month.

A special meeting of shareholders in the Tillsonburg, Lake Erie and Pacific Railway is to be held on September 20th to consider a proposal to lease the line to the C.P.R.

Two surveying parties are at work on the proposed Kootenay Central Railway, one surveying from Golden toward Fort Steele, and the other from Fort Steele to Golden.

Ten new passenger locomotives of the "900" class, and 20 new freight engines of the "800" compound type, are now in process of building at the G.T.R. Montreal shops, for service on the middle division. It is expected that the whole thirty will be in service before winter.

H. R. Charlton, chief of the advertising department of the Grand Trunk, has become an explorer. He, with J. W. Swan, official photographer, and W. E. Davis, son of the passenger traffic manager, made a voyage through Lake Temagami, Lady Evelyn Lake, Willow Lake, and a number of the tributary streams, returning to Temagami village by way of Montreal river and another chain of lakes. Mr. Charlton and his companions say the scenery of this region is entrancing, while the fishing is phenomenal. The new railway from North Bay to New Liskeard will be in operation next year, rendering this virgin territory easily accessible to the sportsman and tourist.

In about a month the Great Northern Railway will abandon 100 miles of its present main line in Montana in favor of a new route covering the same distance which strikes north from Columbia Falls to a junction with the Fernie, B.C., branch at Rexford, thence back again over the Fernie branch to the main line at Jennings. The existing main line will become a branch and fourteen prosperous main line towns will be cut off from the principal channel of the through business. By the abandonment of the 100-mile section, President J. J. Hill will secure a minimum grade for the Great Northern, which he claims to be slightly less than that of any of the American trans-continental routes. The new route will be used by all through trains of heavy tonnage, while lighter freights and local passenger trains will continue to use the old route, which will still be kept up.

TELEPHONE AND TELEGRAPH.

The Bell Telephone Co. has opened a system in Burford with twelve subscribers.

The telephone is being used instead of the telegraph for signalling and general purposes on the Temiskaming Railway.

The Newfoundland Government's wireless telegraph system, on Labrador, is now in operation. Stations are situated at Venison Island and Battle Harbor.

Kingston's offer to the Bell Telephone Company for phone rates of $20 and $25, instead of $25 and $30, and no bonus of $700, has been refused by the company.

The International Telephone Co., composed of local men, has been formed at Fort Frances, Ont., and is at work putting in an independent telephone service for the town.

The Union Telephone Co., New Brunswick, has extended its system from Woodstock to Hawkshaw and Canterbury. The line is metallic circuit, equipped with Kellogg telephones.

A new telephone company, consisting of Canadian and American capitalists, is being formed in Buffalo. Specifications for installing a system in Toronto have been asked for by the promoters.

The Government has announced its intention of establishing Marconi stations at Pictou, N.S., and Charlottetown, P.E.I., and also to equip the Government steamers, Minto and Stanley, with Marconi apparatus.

A factory for the manufacture of all kinds of telephone supplies is to be erected in Windsor, Ont. The factory will employ over one hundred hands, and will supply the independent telephone companies of Canada.

The Marconi Wireless Telegraph Co. are now transmitting commercial messages to incoming and outgoing steamships from Fame Point, Heath Point, Point Amour and Belle Isle, at a toll of $2 per ten words.

London city council has granted the Bell Telephone Company an exclusive three-year franchise, to date from 1st January last, at a yearly rental of $2,500, being an increase of $1,500 per annum over the expiring franchise; rates to remain as at present.

The Ontario Independent Telephone Co. has applied to the Walkerville council for a franchise. The company is seeking a service in Windsor, Walkerville and Sandwich, giving connection with the co-operative company in Detroit. The Bell Co.'s franchise, in Walkerville, expires in November, and in Windsor in two years' time.

In Prince Edward Island it is necessary to pay fifty cents for a telegram, and there is no night service. The Anglo-American Cable Co. has a monopoly of the business between the island and the mainland. Negotiations are now on between the Government and the Cable Co. looking to a reduction of tolls and improvement of service.

J. A. Carmichael, construction engineer of the Bell Telephone Company, is in Winnipeg, with plans for the proposed extension to the company's buildings in that city. The plans call for a $50,000 building, which will enclose the old one on two sides, and will nearly treble the present office capacity. The top floor will contain a 20,000 multiple switch, now under construction.

The annual convention of the International Union of Architectural Ironworkers will be held in Toronto on September 19th. A number of questions important to the union will be discussed, and 225 delegates are expected to be present from all parts of the United States and Canada. One of the new propositions will likely be the adoption of the eight-hour day for Canadian workmen.

The Montreal Harbor Commissioners have rescinded their contract with the Canadian Inspection Co., for the inspection of steel to be used in the construction of new sheds. It is claimed that the contract was incomplete, and that the proposed inspection is more thorough than necessary, the Inspection Co.'s price being 62 cents per ton, whereas a shop test at 25 cents per ton is thought to be sufficient.

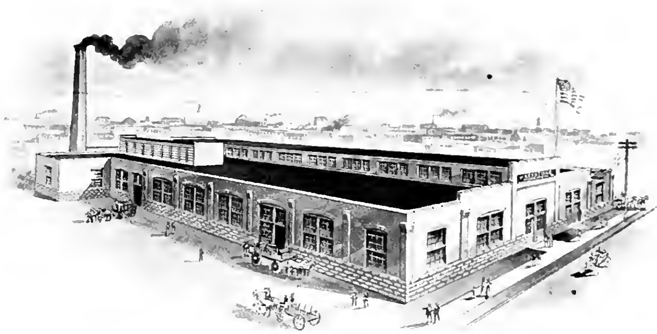
—The Chester Steel Castings Company, of Philadelphia, state that the recent fire at their plant was small and in no way curtailed the output, the fire being confined to one furnace and the building immediately over same. The damage done to the building is now being repaired by local builders. The company sustained no loss greater than the loss of the use of one furnace for a time, no damage being done to power and equipment, and two days after the fire the plant was in full operation and ready to handle any order in sight.

On the application of the Bank of Toronto, George Taylor, M.P., has been appointed liquidator for the business of the Canada Cabinet Co., of Gananoque. The company was incorporated in August, 1901, as the Morden Manufacturing Company. In 1902 it was reincorporated as the Canada Cabinet Co., with a capital of $100,000. Of this $78,000 has been subscribed, and $58,800 paid up. The directors are: Samuel Carsley, F. W. Gross, R. Wilson Smith, Frank Summer, W. W. Williamson and R. J. Dale, all of Montreal; George F. Emery, of Gananoque. A local paper states that the business was a paying one, and financially sound if there had been harmonious action by those who controlled it. There is some expectation that it may pass into the hands of those who can continue it successfully.

THE KEYSTONE MANUFACTURING CO.

The accompanying cut shows the plant of the Keystone Manufacturing Co., makers of ratchet drills and Westcott adjustable "S" wrenches. The building is situated at 41 to 51 Chandler St., Buffalo. It is 80 by 138 feet with an L 18 x 18 feet, and is all of one story, 15 feet in height. It is on a lot 180 x 140 feet, leaving room for additional buildings when required.

The building is constructed of stone, brick, iron and steel, the roof being of expanded metal and concrete fire-proofing, the only wood used being in doors, windows, partitions and floor, the latter of which is of oak and maple, 3¼ inches thick, and resting on oak sleepers on solid ground, filled in with cinders, practically fire-proof. The plant is divided into seven departments—machine shop and tool-room, blacksmith's shop, polishing room, shipping and stock-room, boiler and coal-room, storage-room and offices. The machine shop is 60 x 138 feet, taking up the entire western side of the building. It contains the electric plant, composed of transformers, switchboard, etc., where current is received from Niagara Falls, and distributed for power and lighting; also 68 special, automatic and other machines, all run by one 40 horse-power motor, suspended from the ceiling. The blacksmith shop is 20 x 48 feet, and is separated from the rest of the departments by brick walls. In it are the forges, annealing and tempering furnaces, and the stock of heavy raw materials used. The polishing room is 20 x 30 feet, and contains the grinding and polishing machinery, run by a 15 horse-power motor. The shipping and stock room is 20 x 30 feet, in which finished stock is kept, and from which shipments are made. The offices occupy 20 x 30 feet, and are conveniently and well fitted up. The entire plant is well lighted and ventilated throughout by large windows and a lantern running the entire length of the building, so that every foot of the interior is equally well lighted and ventilated. The heating system employed is what is termed the "over-head system," all the pipes and radiators being suspended from the ceiling, and out of the way. It is a comparatively new system, and worked very well in this plant during the trying winter past. The company now employ sixty-five men.



PROTECTION OF LIFE FROM HIGH-TENSION CURRENTS.

The death, on July 7th, of Percy Smith, a Grand Trunk fireman, as the result of grasping a live wire belonging to the Toronto Electric Light Co. brings into prominence the danger from wires carrying high tension currents. The verdict of the coroner's jury in this case, charging the company with culpable negligence, was a serious indictment. Another similar accident followed on August 10th, when J. H. Fowler, a painter, was killed at the Hamilton [illegible] Bridge Works by coming into contact with [illegible] wire carrying 2,200 volts as he was descending from a scaffold. While there is no need to minimize [illegible] in these cases, such accidents should be impossible. In view of the rapid development of long distance power transmission it is very desirable that some legislation should be enacted which would compel electric light and power companies to provide against fatalities from electric shock.

In Great Britain, where there is an entire immunity from accidents of this nature, electric light and power companies are controlled by the Board of Trade, a Government department, and all work has to be carried out in accordance with the rules laid down by that body. The following are some of the more important rules, and we would point out that, had these regulations been in force in Toronto, the unfortunate victim of the Parkdale fatality would be alive to-day:

Rule 1. "An aerial conductor in any street shall not in any part thereof be at a less height from the ground than twenty feet, or where it crosses a street thirty feet, or within six feet of any building or erection other than a support for the conductor, except where brought into the building for the purpose of supply."

Rule 9. "Every high-pressure aerial conductor must be continuously insulated with a durable and efficient material, to be approved by the Board of Trade, to a thickness of not less than one-tenth part of an inch, and in cases where the extreme difference of potential in the circuit exceeds 2,000 volts, the thickness of insulation must not be less in inches or parts of an inch than the number obtained by dividing the number expressing the volts by 20,000. This insulation must be further efficiently protected on the outside against injury or removal by abrasion."

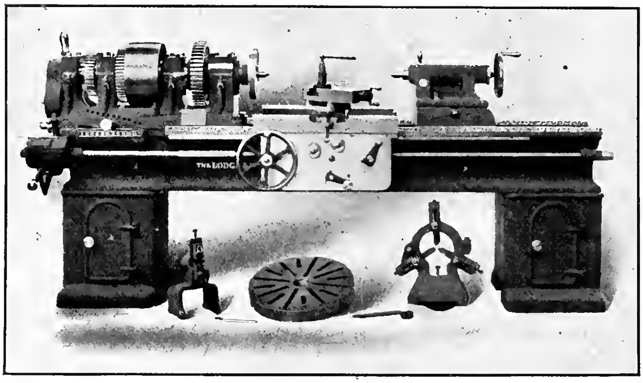
Rule 10. "The material used for insulating any high-pressure aerial conductor must be such as will not be liable to injurious change of physical structure or condition when exposed to any temperature between the limits of 10° F. and 150° F., or to contact with the ordinary atmosphere of towns or manufacturing districts."

Rule 11. "The insulation resistance of any circuit using high pressure aerial conductors, including all devices for producing, consuming, or measuring energy, connected to such circuit shall be such that, should any part of the circuit be put to earth, the leakage current shall not exceed 1-25th of an ampere in the case of continuous currents, or 1-50th of an ampere in the case of alternating currents. Every such circuit containing high-pressure conductors shall be fitted with an indicating device, which shall continuously indicate if the insulation resistance of either conductor fall below the conditions required by this regulation."

Rule 12.—"Every aerial high-pressure conductor shall be efficiently suspended by means of non-metallic ligaments or suspending wires, so that the weight of the conductor does not product in it any sensible stress in the direction of its length, and the insulated conductors and suspending wires, where attached to supports, shall be in contact only with material of highly insulating quality, and shall be so attached and guarded that in case they break away it shall not be possible for them to fall away clear of the support."

Rule 15.—"Every aerial conductor, including its supports, and all the structural and electrical appliances and devices belonging to or connected with such conductor shall be duly and efficiently supervised and maintained for or on behalf of the owners as regards both electrical and mechanical conditions."

It will be seen that in the matter of regulations protecting life and property from the dangers of high-tension currents Great Britain is much more advanced than this Dominion, and, while it may be too much to expect that similar conditions could be obtained in the less populated districts of Canada, so far as the cities and towns are concerned, the adoption of some measures to render accidents from electric shocks impossible is most certainly an urgent necessity. The proper place for all wires in the larger cities and towns is underground, but failing that, no laws can be too stringent for the protection of human life.



NEW PATENT HEAD LATHE.

The lathe here represented is made by the Lodge & Shipley Machine Tool Co., Cincinnati, Ohio.

The aim in the design of the head has been to provide a lathe that will maintain its life and accuracy and stand the hard abuse that a machine of this class is subjected to with the use of high speed steels. The construction of the pulley and sleeve is such that there is no belt strain whatever on the spindle—this is taken care of by two bearings that support the pulley sleeve independent of the spindle bearings. The sleeve has a hole through its centre, which is one-eighth larger in diameter than the lathe spindle, so that there is no point of contact between the sleeve and spindle. By this means we are able to supply the necessary high speeds through our back gears without running the pulley on the spindle, thus eliminating nearly all friction. The regular engine lathe is short-lived and troublesome in this respect when using high speeds and impossible to oil. The end of the pulley sleeve has a positive clutch so that it can be engaged with one which slides on the inside hub of the face gear. This in turn is operated by a lever handy to the operator for engaging the spindle or the back gears. On the pulley sleeve are keyed two gears of different diameters into which either of a pair of sliding gears on the back gear shaft can be engaged. The ratios of these gears are 3 to 1 and 9 to 1. The pulley on the sleeve is of a large diameter and made to take a much wider belt than formerly used on the standard cone pulley engine lathe. The spindle of the head is mounted in bearings, but passes through the pulley sleeve and does not fit, having one-eighth of an inch of clearance. From this it can be readily understood that when the head is at work there is no pull of the belt on the spindle. The belt pull is taken entirely by the bearings that support the pulley sleeve, as is also the pressure of the driving gears. This feature will add greatly to the life of the spindle bearings, and enable the spindle to maintain its perfect alignment many times longer than the old construction. The back gearing now revolves as one piece on its own journals, and in self-oiling bearings with a novel means of engaging and disengaging. This will be recognized at once as a much-desired improvement.

Oiling has been given a great deal of consideration, and it is stated that the oiling device will run at least three months at one oiling. The construction of this is such that it is impossible for any oil to get out of these bearings. Deep oil wells are cast in the centre of the bearings for the spindle and sleeve, and hold at least one pint of oil each. On the front of the head on each of these bearings is a lug which is bored out and a glass tube inserted in such a manner as to always show the level of the oil. Mounted on the spindle and sleeve and made to turn with them are brass rings with projections, on the principle of the "Bucket Pump," that have holes bored in the projections, so that when spindles are turning, these dip the oil out of the wells, and as they pass over the centre of the spindle they drop the oil onto the spindle, and continue to do this regardless of the speed at which the spindle revolves.

This is not a high-speed lathe only. It can be used to equal or better advantage on any class of work that has been done on the old type of cone pulley head engine lathe. None of the good qualities of an engine lathe are lost and many new good qualities are gained, notably about double the power.

The lathe is furnished with a countershaft giving the necessary speeds to operate, as above described, which is if anything simpler than the old style countershaft.

The details of the lathe, other than the head, are the same as those of the Quick Change Gear Lathe, made by the same company.

	20 in. Lathe, with usual cone pulley.	20 in. Lathe, with new patent headstock.
Pressure exerted by belt on spindle bearings in lbs. per square inch of bearing surface......	17.6	None.
Pressure exerted by belt on spindle between bearings which affects the alignment of the spindle	393 lbs.	None.

Construction of Sydney Mines (C.B.) waterworks is being commenced. D. Sutherland has the contract.

The Canadian Engineer

VOL. XI.—NO. 10. TORONTO AND MONTREAL, OCTOBER, 1904. PRICE 10 CENTS / $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY, MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada, Great Britain and the United States, $1.00 per year, foreign, 6s. Advertising rates on application.

OFFICES—18 Court St. Toronto; and Fraser Building, Montreal.
Toronto Telephone, Main 4310. Montreal Telephone, Main 2589.
BIGGAR-SAMUEL, LIMITED, Publishers,

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 15th of the preceding mooth or if proof is desired, 4 days earlier.

CONTENTS OF THIS NUMBER.

A CANADIAN COMMISSION TO NEWFOUNDLAND.

The St. John's Trade Review, taking up the question of trade between Canada and Newfoundland, discussed in the August number of the Canadian Engineer, essays to give some of the reasons why United States firms have got ahead of Canadian firms in cultivating trade on the island. Our contemporary says United States manufacturers have gained most in those lines that are of their own manufacture, whereas in the past Canadian firms have been selling goods, a large proportion of which are not of Canadian manufacture, but imported and reshipped to the island. The Review then quotes the interesting letter of the Toronto Globe's special correspondent, in which attention was called to the work of the United States consul at St. John's, who, while personally very popular among the islanders, never loses an opportunity of giving hints of trade openings to United States manufacturers.

As to the first point raised, our contemporary proceeds to say: "All the United States goods we import are manufactured in the United States and have no previous duty handicap, while the most of the goods Canada has to sell us have come from some other country. If Canada is content in exploiting her own bona fide products here, we will show her a fair field and no favor, but products of other countries coming to us through the Dominion (except in bond) cannot be expected to get a foothold." We fancy there is a misconception here, due to the fact that a large retail trade by parcels post has sprung up between some of the Canadian departmental stores and Newfoundland; and these goods, which would be of all sorts and from all countries, are taken as typical of the business of manufacturers and shippers. This trade, it is said, is turning out rather unsatisfactory to the islanders, who, in many cases, find the goods unsatisfactory, but will not or cannot return them; but, lest it should work harm to the future trade of Canadian manufacturers and merchants, those concerned should get into closer touch with the island and make known the variety and extent of Canadian products which already find, or should find, their way to the island under their own colors.

The second point is equally serious to Canadians who wish to increase their trade with Newfoundland, and it is of importance from a national and political as well as an industrial and commercial standpoint. Canada has commercial representatives in Australia, South Africa, Great Britain, France and other countries. Why should she not have a commissioner in Newfoundland, who, through our Government, would keep Canadians posted on trade conditions and on opportunities for Canadian manufacturers? A discreet man of the type of the United States consul, so highly praised by the Newfoundland papers, would be a great power for promoting good relations between Canadians and Newfoundlanders. He would be a man who would have enough sense to keep himself out of the domestic politics of the island and take no part in sectional contests, but would go among the merchants and people, giving them information on the country, and showing them that we were a friendly and fraternal people, with a real interest in the island's prosperity. He could prove this by calling the attention of Canadian manufacturers to the openings for Canadian capital and enterprise there, and this feature of his work would be an earnest to the people of the island of the advantages of closer commercial and social relations with Canada above all countries except the Mother Land. A Newfoundland commissioner in Canada would be a complement to the work of the Canadian commissioner at St. John's. Such a commissioner would do good service to his country if all he accomplished was to direct the attention of enterprising Canadians to fields of investment in developing the resources of the island and giving better employment to its people.

THE MANUFACTURERS AND THE LABOR CONGRESS.

The annual convention of the Canadian Manufacturers' Association and the annual congress of the Trades and Labor organizations, both of which were held in Montreal in the same week last month, have proved the most important in the history of both bodies, not only because the attendance was the largest on record, but because of the character of the resolutions passed. The Canadian Manufacturers' Association, which now numbers 1,511 in its firm memberships, passed resolutions re-affirming previous resolutions calling for a general revision of the tariff on the broad lines of adequate protection to all native industries, even including the agricultural interests and the fisheries and forests. The preference in favor of Great Britain and the British colonies is approved of as against foreign countries, but the association does not favor a preference involving the extinction of a native Canadian industry; nor does it approve of a system of bounties as a substitute for protection. Whatever difference of opinion may exist among outsiders as to these questions, we fancy there will be a general endorsation of the resolution to organize a fire insurance company as a protest against the attempt of the regular insurance corporations to make the merchants and manufacturers of Toronto and the Province of Ontario pay for the fire of last April by an extra assessment that bears no relation to normal risks. We understand that steps will be taken to create this insurance organization at once. The proposal made for an association trip to the Old Country next summer is one which, if carried out, may have important results by bringing British and Canadian manufacturers into closer touch, and leading them into co-operation instead of competition.

The Trades and Labor congress, which comprised forty-eight councils and twenty-three federal unions, with an aggregate membership of 22,000, exclusive of twenty-one unions not affiliated, took high ground in the conduct of their convention. Indeed, the leaders viewed the facts around them with a breadth of vision and a statesmanship that did equal honor to their heads and hearts, and is in most favorable contrast to some of the eccentric legislation of similar bodies abroad. The congress passed a resolution in favor of better observance of the Sabbath, and one calling on all the unions to urge their members to abstain from intoxicants. Another very important resolution was one in favor of the Government ownership of telephones, and asking for legislation favoring the municipal ownership of local lines. This was carried unanimously, and another resolution passed asking the Quebec Government to appoint competent boiler inspectors to prevent loss of life by explosions. Not the least hopeful sign of a broader and more tolerant spirit in trades unionism in Canada was the resolution proposing a conference with the Canadian Manufacturers' Association with a view to arriving at a peaceful method of settling disputes between capital and labor. Such a proposal not only shows that the labor men recognize the enormous loss to both sides involved in a dispute as to wages, etc., but it also implies a recognition that capital has a right to a fair return for its use and investment. If, as we hope, the Canadian Manufacturers' Association and others representing capital, such as the railway and street railway corporations, will meet the Trades and Labor Committee with a serious determination to adjust differences, each seeing the other's side of the case, a new era will dawn in the industrial history of Canada. Millions of money would be saved that is now worse than squandered in contests that leave nothing but bitterness behind; and, what is more vital, the moral degradation of enforced idleness and the deprivations that innocent people have to suffer would be reduced immeasurably. But capitalists and employers of labor must remember that their responsibilities for the right use of money and position are heavy.

THE VISITING ENGINEERS AND ELECTRICIANS.

The visit to Canada last month of so many representative members of the Institution of Civil Engineers of Great Britain is a timely one, and should result in much good to both countries. Engineers are not much given to speech-making, but are men who "do things," and the few remarks made in public by our British visitors show that their practical minds have quickly grasped the importance of Canada as a pillar in the edifice of empire. The penetrating mind of Sir William White, for example, realizes instantly the potentialities of the colossal water-powers of Canada and the unspeakably lavish gifts of nature in the way of navigable lakes and rivers, to say nothing of sea coasts. We know something of the value of these water-powers from the industrial activities created by the use of the few that are already developed, but who can measure the industrial forces to be brought into the service of the country by the water-powers yet undeveloped and unknown? Within a radius of fifty miles of Ottawa a million horse-power has been measured, of which not one per cent. has been electrically utilized. In northern Canada we know, from the nature of the country and the source of the rivers and streams, that there are water-powers by the hundred yet unmeasured, or even explored. The statement that Canada contains 40 per cent. of the water-power of the world may prove to be within the mark rather than outside. These powers, combined with our enormous mineral, timber and agricultural resources and our vast systems of inland navigation are not put here by Providence for Canadians to boast possession of merely They are a trust which it is our duty rightly to use for the benefit of the world, ourselves included, and to turn to account in behalf of the millions who will shortly seek homes in the vast unoccupied lands of the British half of America. In this great task our admitted present lack is capital, and our British visitors can, and no doubt will, direct their friends at home to safer channels of investment in the country than many British capitalists have unfortunately been led in the past through the speculative promoter. It is not only in this respect that

the visitation will do good to both countries, but our visitors on their return home will be able to confirm what the Canadian Engineer has preached from time to time—that British engineering firms have in the past ten or twenty years been asleep to the business opportunities that are passing in this country. There is no reason that we know of—except apathy—why orders for machinery to the extent of millions of dollars should not have been secured by Old Country makers instead of passing into the hands of United States, German and other foreign manufacturers. Our visitors can tell their friends at home that though they may regard with a supercilious smile the loss of a trade of the modest dimensions which the Canada of to-day has to offer, they or their sons will be fighting for their life for the same trade when this country has become a nation of twenty or thirty millions. It is easier to save a trade by a few timely reforms and a little attention to the wants of customers than to regain it after it has drifted into new channels. Whatever the results from a business point of view, it is pleasing to learn that not only the British civil engineers, but the British and Italian electricians who also visited us last month were gratified with the hearty hospitality of their Canadian confreres. It is pleasing further to hear that they are being received with equal cordiality by our generous professional friends in the United States who have done many mighty works in the engineering line which they can show with just pride.

—The trend of modern practice in protection against fire is toward the provision of permanent stationary fire-fighting apparatus. As an instance, the city of Philadelphia recently completed an independent system of high-pressure mains and pumping station. The value of private fire apparatus for the protection of individual buildings and adjoining property was thoroughly demonstrated in the Baltimore and Toronto fires; and, in fact, the fire departments of both cities admit that many buildings on the immediate margin of the devastated tract were saved only by the effective work of private apparatus. These buildings were supplied with either stand-pipes or pumps connected with wet-pipe interior sprinklers and dry-pipe sprinklers for protection from outside fires, storage tanks holding from 1,500 to 15,000 gallons being placed on the roofs. Besides saving the buildings in which they were located, these equipments stopped the advance of the fire, and undoubtedly many more buildings would have been destroyed in the absence of their efficient service. It is said that the buildings and contents protected by private apparatus in Baltimore were valued at five million dollars, and at Toronto the saving from private protection was similar in extent.

—A high-speed pump, driven without gears or belt directly from the shaft of an electric motor, was recently tested at the works of the General Electric Co. at Schenectady, N.Y., and showed an efficiency of 93 per cent. when running at a speed of 300 revolutions per minute. This is interesting, since electric-driven pumps of the reciprocating type involve heavy and expensive gearing. In mining operations especially the use of steam for driving pumps at a distance has drawbacks owing to loss of steam by condensation and owing to troubles with long lines of pipe, which, apart from their cost, are liable to leaks and danger of bursting, and the delays attendant thereon. Compressed air, so largely used in mining, is a convenient way of distributing power, but it has a low efficiency in the plant as a whole. Where first cost is not the chief consideration, the electric direct-driven pump should do good service, as the system would be capable of easy extension while admitting of the centralization of the power plant. In most Canadian mines, however, electricity is generated by water power, and first cost and simplicity rather favor the turbine pump, for low first cost seems to be the chief object in the installation of many Canadian plants. However, we understand that the John McDougall Caledonian Iron Works Co., of Montreal, are experimentally putting this type of pump on the market, and it will be interesting to observe how they are found to work.

RAILWAY DISASTERS.

A head-on railway collision, at Richmond, Que., in which eleven people were killed and over a score injured; a rear-end collision, at Sintaluta, between an express bearing the Governor-General, and a freight, in which five were killed and as many injured; a rear-end collision, between two freights, at Eastwood, Ont., in which five were killed, besides a number of cattle burned to death and nine cars destroyed; a wreck at Streetsville, Ont., through a broken axle; a collision at Oak Point, Man., resulting in injuries to four; the derailing of an express near Moosomin, N.W.T., from which seven people were injured; the derailing of a freight near Milton, Ont., from which one was killed and two injured—these, with a few minor accidents, make a dark record of disaster on Canadian railways within the space of thirty days. The direct loss to the railways in wrecked rolling stock and damages will not be less than a million dollars; but the grief of widows and children, and the loss to the State of good citizens, cut off generally in the prime of life, cannot be measured in terms of money. We have not followed the disaster list in the United States for September, but the case of the head-on collision of two passenger trains, near Hodges, Tenn., on the 24th ult., where 54 were killed and 125 injured makes in itself a frightful catalogue of death and damage. In all but the minor cases these accidents would have been practically impossible had the block signal system of Great Britain and European countries been in operation on these railways. Apart from the defects of the present signaling system, the railways of this country and the United States perhaps more particularly the latter are suffering in reputation by a fit of severe economy in the operating department, while maintaining a generous expenditure in the directorate and high official lists. We do not say that many of these high officials do not richly earn their large salaries, for their responsibilities are very heavy in more ways than one, but as regards the train men, station agents, etc., it is certain that they cannot efficiently fulfil the duties assigned to them and live up to the rules laid down for their direction. It must be confessed that in care and efficiency of operation, Canadian and United States railways cannot compare with British roads. The London and North-

Western and other British railways have run a whole year at a stretch without losing the life of a single passenger. Contrast this with the record of the fiscal year in Canada, in which 420 people were killed and 1,453 injured on the railways. An investigator of railway accidents was recently appointed by the Dominion Government. The idea of such a reporter is a good one, but the public has so far seen little or nothing of the results of his work. If these reports are to be pigeon-holed, they are not much advantage to the country. The new Railway Commission has got fairly to work and has already justified its existence, but the casualty record of the past month shows that it has before it more serious work than it has yet contemplated.

MACHINE SHOP NOTES FROM THE STATES.

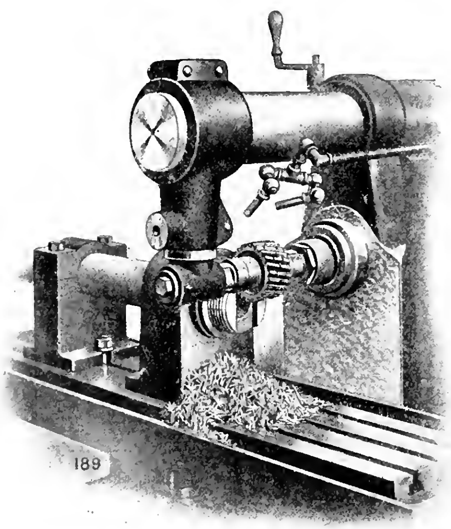
By Chas. S. Gingrich, M.E.

VIII.

"Don't bother about changing all your patterns so that you can use castings in the rough, because by allowing 'finish' you can mill them quicker than file the lumps off." This statement was made to me while going through the milling department in the shops of the Cincinnati Milling Machine Company recently.

This seemed like pretty strong talk, but before I had a chance to question it I was shown a job which fully bore out the truth of the statement. Permission to make a photograph was granted, and it is reproduced herewith.

This is one of the braces that go with each milling machine. It is a simple cast iron bar having a long bolt slot through its centre by which it is clamped in position, the slot allowing for a great deal of vertical adjustment. It had been the custom for years to core this slot in the casting, accuracy being of no particular importance; but no matter how careful the moulder was, it was always necessary to smooth the slot with a file before the pieces could be used.



No. 2 Plain Cincinnati Geared Feed Miller, with Power Vertical Feed.

The slots are about 22 inches long, and if a man cleaned one of these up by hand in ten minutes he was doing very well; but to refer to their present practice: The pieces are now cast solid. A single hole is drilled through the bar at one end of the slot. It is then secured to the milling machine table, and adjusted to bring this hole in line so that the piece can be slipped over a small end-milling cutter of proper size, which is held in the spindle of the machine, and the slot is then milled out of the solid metal and finished to size at a single cut. It takes just about five and a half minutes to mill one of these slots. The cutter used is 13-16 inches diameter, Novo steel, and runs about 480 revolutions per minute. The bars are 1¼ inches thick.

There were other machines at work on a variety of pieces, which proved conclusively that the above statement, that it does not pay to file up rough castings, applies just as well in the case of bearing caps, couplings, etc., as it does in the case of the particular piece illustrated.

The Victorian, the first of two turbine-driven ships for the Allan Line, has been launched at Workman, Clark & Co.'s yard, Belfast, and it is expected that she will be ready for service before the end of the year. She will be fitted with Parsons turbines.

The Minister of Railways has appointed E. J. Walsh, C.E., to be engineer in charge of surveys in connection with the Trent Valley Canal. One of these will be along the Port Hope route to Lake Ontario, and the other will be for the purpose of determining the best channel between Lake Simcoe and Georgian Bay.

The Department of Marine and Fisheries has begun the making of a hydrographic survey of Lake St. Francis, which will dovetail into the similar work done by the United States Government a few years ago. The party consists of about sixteen men. The work will be under the charge of Mr. Chapleau, Chief Engineer of the Department of Marine and Fisheries.

—Two Sheffield workmen, John Creswick and Herbert Shaw, after three years of experimenting, have discovered a process of electroplating with aluminum. Thousands of pounds have been spent by silversmiths of Birmingham and Sheffield in developing an aluminum electroplating process, but no method could be devised of making this metal "take" on another metal. Creswick and Shaw have found a solution which, by immersion before being subjected to the battery, will accomplish the result. The process, which is patented, is applicable to any articles now made in nickel or Britannia ware, and the inventors have started a small factory for plating goods.

NEW INCORPORATIONS.

The Continental Contracting Co.; capital, $500,000; head office, Ottawa. Directors: W. H. Curle, J. T. C. Thompson, J. Connolly, A. R. Fraser, and G. A. Brown, all of Ottawa.

Compagnie Générale d'Entreprises; capital, $1,000,000; head office, Montreal. Directors: F. Allard, L. Coiseau, A. Couvreux, J. Dollfus, A. Duparchy, L. Wiriot, contractors, all of Paris, France; J. Nyssens-Hart and J. Cousin, both of Bruxelles, Belgium, and J. de Shryver, of Raismes, France.

Canadian Pipe Co.; capital, $25,000.

The Ontario Independent Telephone Co.; capital, $100,000; head office, Windsor. Directors: C. W. Taylor, J. R. Brooks, J. A. McRae, P. T. Chesley, and A. D. Prosser, all of Detroit.

The charter of the Niagara Falls Park and River Railway Co. has been transferred to the International Railway Co., incorporated in New York State.

The Minnehaha Mining and Smelting Co., of Arizona, is licensed to do business in Ontario to the extent of $40,000 capital.

The Crown Oil Co. is incorporated with a capital of $300,000; head office, London. Directors: D. S. Robb, of London; B. G. Baker, of Buffalo, and others.

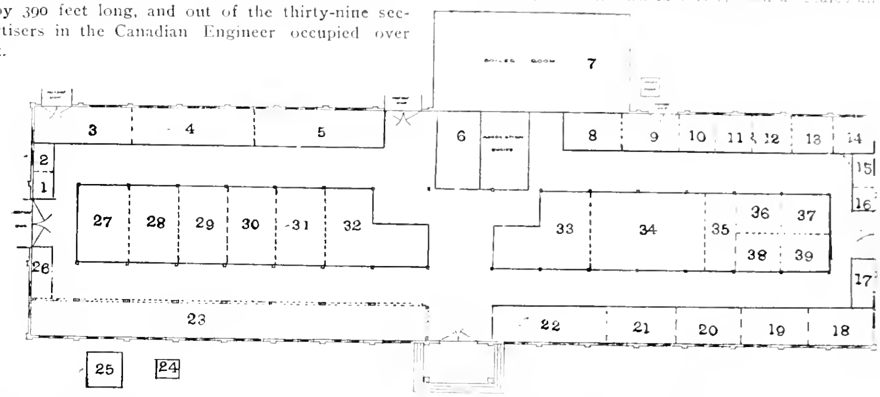
The Mount McKay Brick and Tile Co.; capital, $40,000; head office, Fort William. Directors: K. O. Brune, F. Waldberg, and others, all of Fort William.

Simplex Coal Saver, Limited; capital, $40,000; head office, Toronto. Directors: P. H. Patriarche, F. B. Allan,. and W Eacrett, all of Toronto.

MACHINERY AND ELECTRICAL HALL, CANADIAN NATIONAL EXPOSITION, TORONTO.

The Exposition of 1904 saw Machinery Hall unable to accommodate the exhibitors requiring space, and as a consequence many of them were forced to secure accommodation in other buildings not so well suited.

The below plan and list will convey an idea of the number of firms who were accommodated in a space 100 feet wide by 390 feet long, and out of the thirty-nine sections advertisers in the Canadian Engineer occupied over 50 per cent.



*4. American Tool Works Co., Cincinnati, Ohio.
*31. Babcock & Wilcox, Limited, Toronto.
9. Biggar-Samuel, Limited—Canadian Engineer, Canadian Journal of Fabrics, Pulp and Paper Magazine.
*23. Canada Foundry Co., Limited, Toronto.
*24. Canada Foundry—Fountain.
13. Canada Metal Co., Toronto.
20. Canadian Bearings, Limited, Hamilton, Ont.
9. Canadian Engineer, Toronto.
9. Canadian Journal of Fabrics.
39. Carey Mfg. Co., The Philip, Toronto.
35. Chapman Double Ball Bearing Co., of Canada, Limited.
*19. Cling Surface Co., Buffalo, N.Y.
29. Consolidated Electric Co., Toronto.
*11. Dominion Belting Co., Limited, Hamilton, Ont.
30. Dodge Mfg. Co., Toronto.
14. Engineer's Office.
*19. Eureka Mineral Wool & Asbestos Co., Toronto.
*4. Fairbanks Co., Toronto, Montreal, Winnipeg and Vancouver.
*9. Georgian Bay Engineering Works, Midland, Ont.
*32. Goldie & McCulloch Co., Limited, Galt, Ont.
5. Goold, Shapley & Muir Co., Limited, Brantford, Ont.
*36. Hamilton Motor Works.
21. Henderson Roller Bearing Co.
*34. Jones & Moore Electric Co., Limited, Toronto.
*16. Ker & Goodwin, Brantford, Ont.
*4. Merrell Mfg. Co., Toledo, Ohio.
6. McLachlan Gasoline Engine Co., Limited, Toronto.
6. McLachlan-Joy Electric Co., Limited, Toronto.
*12. McLaren, D. K., Montreal, Toronto.
*10. McLaren Belting Co., The J.C.
*22. Morrison Brass Mfg. Co., Limited, The James, Toronto.
9. Pulp and Paper Magazine of Canada.
18. Queen City Cycle and Motor Works, Toronto.
*19. Quaker City Rubber Co., Philadelphia.
17. Shankland, W. S., Toronto.
17. Sinclair & Sons, G. S., Wiarton.
*36. Smart Turner Machine Co., Hamilton, Ont.
*19. Smooth-On Mfg. Co., Jersey City, N.J.
8. Syracuse Smelting Works, Montreal, P.Q.
*37. Toronto and Hamilton Electric Co., Hamilton, Ont.
25. Toronto & Niagara Power Co.—Tower.
7. Underfeed Stoker Co., Limited, Toronto.
*33. United Electric Co., Limited, Toronto.
28. Vessot & Co., S., Joliette, P.Q.
*7. Waterous Engine Works Co., Limited, Brantford, Ont.
38. Weddell Bridge & Engineering Co., Trenton, Ont.
*26. Westinghouse Electric Mfg. Co., Pittsburg and Hamilton.
3. Wilson & Son, Chas., Toronto.
17. Williams, Wayland, Montreal.
27. Williams Machinery Co., A. R., Toronto.

**Names marked with star are those of advertisers in the Canadian Engineer.*

The arrangements made by H. G. Nicholls, chairman of the Machinery and Electrical Committee, who was ably assisted by A. M. Wickens, superintendent, and W. G. Blackgrove, engineer, were very much in advance of former years, and on the closing night of the Exposition an address was presented to the chairman, a wallet was given to the superintendent, and a sum of money to the engineer and his assistant, to which every exhibitor in the building contributed. The recipients expressed their appreciation in short speeches.

Through the courtesy of G. W. Thexton, manager of the Georgian Bay Engineering Works, the publishers of the Canadian Engineer were allowed desk room in his space, the position at the western entrance formerly allotted to the Canadian Engineer, and again promised us this year having by some misunderstanding been given to another exhibitor.

Notes of the Fair.

The Canada Foundry Co., Limited, and the Canadian General Electric Co., Limited, had the most extensive exhibit in the Hall, as well as an outside exhibit on the south side showing the style of tower being erected for the long distance line of the Toronto and Niagara Power Co., and also several fountains.

Dr. W. D. Young, of the Cling-Surface Co., Buffalo, visited the Fair during the opening days and installed the testing machine in the exhibit of the Eureka Mineral Wool and Asbestos Co.

Mr. Walker, manager of the Dominion Belting Co., Limited, Hamilton, Ont., spent a [illegible] at their exhibit.

The Eureka Mineral Wool and Asbestos Co., Toronto, in addition to their own products had an attractive exhibit of packings manufactured by the Quaker City Rubber Co., Philadelphia, and cements made by the Smooth-On Manufacturing Co., Jersey City, N.J.

The Fairbanks Co., in addition to the standard products made in their own factories, such as scales and valves, exhibited the "Fairbanks" brand of leather belting and wood split pulleys made in Canada, named the "Fairbanks." Their exhibit was crowded with interested visitors, who were either getting weighed on one of their handsome weight-registering scales or admiring the new high-speed lathe, made by the American Tool Works Co., Cincinnati, Ohio, or watching the operations of "Fairbanks" gas and gasoline engines. They also showed a pipe-threading and cutting machine made by the Merrell Manufacturing Co., Toledo, Ohio; Foster pressure regulating valves; Goddison's magnetic igniter for gas and gasoline engines, a new method which will supersede the use of batteries. There was also a "Fairbanks" power hammer and the products of the Burt Manufacturing Co., Akron, Ohio, comprising "Cross" oil filters and "Burt" exhaust heads.

The Georgian Bay Engineering Works, Midland, Ont., showed a 4 h.-p. gasoline engine, which attracted much attention owing to its simplicity and easy-running qualities, details of which will be found in their advertisement.

The Goldie & McCulloch Co., Limited, Galt, Ont., whose engine supplied the power for the main drives in Machinery Hall (one being a Wheelock and the other a high speed Ideal) also showed a milling separator, wheat steamer, four-sided moulder, double-surface planer, and a power feed cut-off saw.

The Hamilton Motor Works and the Smart-Turner Machine Co., Limited, Hamilton, Ont., exhibited marine gasoline engines and steam pumps of great variety.

The Jones & Moore Electric Co., Limited, Toronto, had an extensive line of bi-polar and multi-polar generators and

motors up to 80 h.p., and supplied a number of the exhibitors with lights. All their motors were connected up, and their switchboard was fitted up with the necessary switches of the most approved types. They also displayed a line of Adams-Bagnall arc lamps, special lamps in great variety, fans, blowers, telephones, etc.

The "Imperial" lathe chuck, manufactured by Ker & Goodwin, Brantford, Ont., had its many good points explained by the members of the firm.

The manufacturers of leather belting, D. K. McLaren, and the J. C. McLaren Belting Co., both had attractive exhibits. The both firms claim to use the genuine English oak-tanned stock.

The James Morrison Brass Manufacturing Co., Limited, Toronto, surpassed even their efforts of former years, and their lines of steam specialties, gas and electric fixtures, bathroom and sanitary equipment were very striking and comprehensive. Their marine brass work attracted attention, as they exhibited a whistle and steam ship telegraph for the new Dominion cruiser "Vigilant."

The Toronto and Hamilton Electric Co., Hamilton, Ont., showed their dynamos, motors and direct connected sets.

The United Electric Co., Limited, Toronto, had an extensive and varied exhibit of dynamos, motors, electrical supplies of all kinds. A "Bell" engine was also shown in operation in their space.

The Waterous Engine Works Co., Limited, Brantford, had a McEwen engine in the boiler-room running the blower for the Underfeed Stoker Co., Limited.

The Westinghouse Electric Manufacturing Co., Limited, Pittsburg and Hamilton, Ont., had arc lamp circuit regulators in operation.

Babcock & Wilcox, Limited, Montreal and Toronto, manufacturers of water tube boilers, showed in addition to a permanent boiler exhibit samples of their solid steel boiler forgings and manhole covers. They also distributed very interesting reading matter, and a limited number of their publication called "Steam" were secured by interested visitors.

NATIONALIZING THE NICKEL INDUSTRY.

The following comes by way of London, through the Daily Chronicle: An important proposal is likely to be made by the Dominion of Canada to the British Government. In the Sudbury district of Ontario there are situated the largest known nickel mines in the world. For commercial purposes there are at present only two sources from which the world's supply of nickel is drawn. One is at Sudbury, and the other is in the French penal settlement of New Caledonia. In the manufacture of guns and armor-plate nickel is an indispensable ingredient. The whole present supply, however, Canadian and French, is controlled by the International Nickel Company, an American trust, which has managed to crush out all its smaller competitors. At the head of this combination is C. M. Schwab, ex-president of the Steel Trust. It has, however, occurred, not for the first time, to some Canadian patriots, that it is absurd that the nickel used in the construction of the iron walls that defend Great Britain, should be purchased second-hand from an American trust while the great source of the supply is on British soil; and it has accordingly been suggested that the invaluable supply in the Sudbury district should be reserved for British use. Apart from patriotism, Canadians have, of course, an eye to business in making this proposal. The International Trust puts an arbitrary price on nickel. Its present commercial value is about 40 cents, or 1s. 8d. a pound, but experienced miners and smelters say it can be mined, smelted, refined, and put on the market at a price not exceeding 6d. a pound. In that case, within the past ten years, the period during which nickel has begun to be extensively used in the building of ships of war, the supply purchased by Great Britain has cost at least 200 per cent more than it need have done. That 200 per cent., it is urged, might have been used in increasing the efficiency of nickel as a defensive material of war.

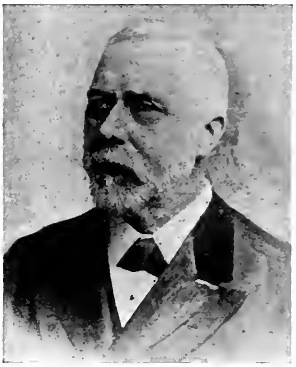
Some months ago the Canadian Government expressed a willingness to make an offer to the British Government of all the nickel in the Sudbury district, provided that the offer was certain of acceptance. It is understood that, before Mr. Chamberlain left the Colonial Office, an undertaking was arrived at on behalf of the British Government that the offer would at least receive most careful consideration. It was added, however, that it would be impossible for the Government to interest itself directly in the production of nickel, but it was pointed out that there would be no objection to the insertion in all contracts issued by the Admiralty and the War Office of a clause specifying that the nickel used in the manufacture of guns and armor-plate should be of British origin and production. France would then probably take steps to reserve the nickel of New Caledonia for her own use, so that the whole supply of the world would practically be in the hands of Great Britain and France. Other countries would have to take what was left at an enhanced price, after the two powers had satisfied their wants. The International Trust would, of course, continue to work its freehold property, but under a severe handicap.

THE BRITISH ENGINEERS' VISIT TO CANADA.

As we go to press, a party of over one hundred members of the British Institution of Civil Engineers is on its way to the International Engineering Congress, to be held in St. Louis the first week in October. The itinerary was so arranged as to include a trip through part of Canada, visiting Montreal, Quebec, Ottawa, Toronto, and Niagara Falls.

The Institution is nearly a century old, and for the first time the members have, as a body, left their headquarters in Great George St., London, and gone abroad. They were received in New York by the American Society of Civil Engineers, at whose invitation they made the trip, and some days were spent in viewing the sights of engineering interest in and about that city.

On Monday, September 19th, the party was conveyed on a special train on the New York Central Railway from New York to Montreal, where they were received by the Canadian Society of Civil Engineers, who were their hosts throughout their visit to Canada.



Sir Wm. White, K.C.B., D.Sc., F.R.S., President, Institute of Civil Engineers.

Tuesday and Wednesday were spent in Montreal. The Canadian Pacific Railway shops were visited, where luncheon was served by the company. Special street cars then carried the party on a trip around the city. Wednesday morning the visitors were taken by special Grand Trunk train to Victoria Bridge, and after a short visit, they proceeded to Lachine, whence a boat, chartered by the city for the occasion, conveyed them to the Soulanges Canal. The return trip was by way of the rapids. In the evening a reception was tendered by the Governors, Principal, and Fellows of McGill University.

Thursday was spent in Quebec, visiting the harbor, the graving dock, the site of the new bridge, and Montmorency Falls. The party left in the evening by the Intercolonial Rail-

way and Canada Atlantic, arriving in Ottawa the following morning.

A busy day was spent in the capital. A reception was held at the City Hall, a luncheon at Hotel Victoria, Aylmer, and a garden party at the residence of T. C. Keefer, who is a member of the Institution. The party also visited the Chaudiere.

Saturday was spent in Montreal further investigating the objects of interest in that neighborhood, and on Sunday the party travelled to Toronto by special train on the Grand Trunk. On Monday, the visitors were formally received at the City Hall and also at the Legislative Building, and a luncheon was tendered by the members of the Canadian Society. Trips around the city and sailing excursions on the bay completed the day.

On Tuesday the party left for Niagara Falls, where they investigated the power developments on both sides of the river, afterward leaving for Chicago.

Sir William White, the president of the Institution, is the head of the delegation, and responded eloquently to the addresses of welcome at the various places. For many years Sir William was chief director of construction, and also assistant controller of the navy. He left the service in 1902, being now a private naval expert. He is an enthusiastic supporter of the navy, which he regards as one of the strongest ties binding the Empire together. In his reply to the welcome by Premier Ross, he remarked that it humbled him when he learned that Ontario is about twice as great as the United Kingdom. "We cannot expand our geographical boundaries," said he, "but we make it up in ships, and we go wherever the ocean rolls, and wherever a British ship floats, there the flag of the British Empire is seen, and that flag must be respected. We claim no exclusive right to the sea, but the sea must always be open to British commerce."

Speaking for the party, Sir William said: "We have seen more than we anticipated, both in work already achieved, and work in hand, and we hear on all sides of works in contemplation. We have seen a nation in its infancy. Although your numbers are small, you have already done wonders, and are facing greater tasks in developing this part of the continent. Those of us who are blessed with this world's goods can find opportunity here for investment, with a security which, combined with patriotism, gives a field for our surplus millions that cannot be surpassed."

In proposing the healths of the King and the President of the Institution of Civil Engineers at the luncheon at Toronto, E. H. Keating, who presided, mentioned several interesting facts relative to the Institution. Among the honorary members of the council are the Emperor of Germany, the King of the Belgians, the Duke of Connaught, and Lord Kelvin, while King Edward is a patron of the Institution. The Institution is now in its 86th year, having been incorporated in the reign of George IV., "for the general [illegible] and more particularly for [illegible] species of knowledge which [illegible] civil engineer, being the art [illegible] great [illegible] power in nature to the use and [illegible] president of the Institution was Thomas Telford [illegible] in this country through his having [illegible] undertaking in Nova Scotia, which was [illegible] national importance, partly for the [illegible] Following him there have been 39 presidents, all men of distinction, and some of world-wide reputation, such as [illegible] Sir William Cubitt, Robert and George Stephenson, Mr. Bateman, Lord Armstrong, Sir Frederick Bramwell, Sir Benjamin Baker, and others. Robert Stephenson was connected with the construction of the Victoria Bridge at Montreal, at that time one of the wonders of the world. Mr. Bateman constructed at Halifax one of the largest graving docks in America, where the speaker, Mr. Keating, had the honor of acting as resident chief engineer.

Following are the members of the Reception Committee of the Canadian Society of Civil Engineers: Col. W. P. Anderson, president; John Kennedy, past-president, chairman; E. H. Keating, past-president, chairman of Toronto Committee; C. H. Keefer, vice-president chairman of Ottawa Committee; St. George Boswell, B.Sc., chairman of Quebec Committee; C. B. Smith, B.Sc., chairman of Niagara Committee; E. Marceau, vice-president; K. W. Blackwell, past-president; Phelps Johnson, R. B. Owens, D.Sc.; D. Macpherson, P. W. St. George, M. J. Butler, W. McLea Walbank, B.Sc.; J. B. Porter, Ph.D.; R. J. Durley, B.Sc.; H. Irwin, C. H. McLeod, M.Sc., secretary.

The members of the visiting party were: Sir Wm. White, K.C.B., D.Sc., F.R.S., president; C. A. Brereton, member of council; Alexander Ross, member of council, chief engineer, Great Northern Railway; W. C. Unwin, B.Sc., F.R.S., member of council, professor of engineering at South Kensington; J. H. T. Tudsbery, D.Sc., member, secretary; H. F. Ashton, D.Sc., member; John A. F. Aspinall, member; J. B. [illegible]; H. O. Baldry, member; William Barrington, member; Charles F. B[illegible]ley, member; J. A. Brodie, member, City Engineer of Liverpool; A. Havelock Case, member; William Collingw[illegible], member; John D'Aeth, member, Government Engineer, Jam[illegible] D'Ae[illegible], Jr.; H. H. Deane, B.A., member; C[illegible] W. Dodwe[illegible], B.A., member; R. A. Hadfield, member; C. P. Hogg, member; S. G. [illegible]fray, member; H. Ross Ho[illegible], M.A., member; R. B. [illegible]; John G. Hodson, member; W. Henry Hunter, [illegible], chief engineer, Manchester Canal; A. C. Hurtzig, member; W. H. Jaques, member; H. F. [illegible], member; Joseph [illegible], member; H. A. F. Macl[illegible], member; Walter P[illegible]S., member; E. C. Murray, member; H. D. Pearsall, member; David F. Roberts, member; Leslie S. Robertson, member; Walter Rowley, member; Percival W. St. George, member; W. A. P. Tait, D.Sc.,

The Visiting Engineers and Their Friends at the Residence of Mr. S. Nordheimer, Toronto.

member; R. J. Thomas, member; Robert Thompson, member; G. H. Thomson, member; W. J. Turnbull, member; H. H. Wake, member; W. H. Wellsted, member; H. P. Allison, associate member; Thomas Arnold, associate member; T. Scott Anderson, associate member; C. J. Seymour Baker, associate member; Robert S. Ball, associate member; Thomas R. Bayliss, associate member; H. F. T. Bode, associate member; E. F. S. Bowen, associate member; F. W. T. Brain, associate member; W. H. Brinckman, associate member; T. Copley Calvert, associate member; J. Campbell-Thompson, associate member; Alfred Chatterton, B.Sc., associate member, Madras, India; Francis G. Coles, associate member; Arthur Coles, O. F. Wheeler Cuffe, associate member, Burma; William Eckstein, associate member; Fred. J. Edge, associate member; S. E. Fedden, associate member; J. M. Gavin, associate member; James Goodman, associate member; Robert Campbell Grant, associate member; C. D. M. Hindley, M.A., associate member; E. P. Hooley, associate member; M. Rhys Jones, associate member; H. Birch Killon, associate member; J. W. Malcolmson, associate member; Mr. Malcolmson, Jr.; R. J. Gifford Read, associate member; Frank Roberts, associate member; R. W. Roberts, F.C.H., associate member; C. P. Sandberg, Jr., associate member; J. R. Sharman, associate member; E. R. Stokoe, associate member; W. C. Wallace, associate member; Francis Wilton, associate member; J. T. Middleton, associate; E. K. Middleton, Joseph Randall, associate, Woolwich dockyard; G. R. Redgrave, associate; F. C. Appleton, student; J. H. Burman, student; F. W. Cable, student; E. C. Q. Henriques, student; O. B. Lacey, student; E. T. Newton-Clare, student; L. T. Payne, student; G. B. Hunter, A. H. White, of H.M.S. Ariadne, son of Sir Wm. White; H. T. Griggs, assistant secretary.

A TIMELY WARNING.

The following circular has been issued by the Canadian Casualty and Boiler Insurance Co., and is being distributed to engineers:

We herewith enclose you a newspaper report of the recent boiler explosion at the works of the Toronto Bolt and Forge Company's mills, Toronto, which you will see was quite disastrous.

This boiler explosion is the third which has occurred during the last three months in the province of Ontario, and in each case the cause has been traced to negligence, demonstrating that boilers do explode, consequently, we now write requesting that you caution your engineer concerning the safety valves, glass water gauge, try cocks and blow-off pipes.

These should always be kept in perfect working order, the first, that it may relieve the boiler of any undue increase of pressure, the second, that the exact height of water in the boiler may always be correctly known, and, the third, that they may not leak and cause a dangerous shortness of water.

SOME USES FOR THE WASTED HEAT OF GAS ENGINES.

One of the most difficult problems in the transmitting or the generating of power is to reduce to a minimum the waste. For instance, in the steam engine every effort is made to reduce, as far as possible, the amount of heat (for heat is recognized as a form of energy) that is radiated from the steam pipes, the cylinder, etc. Not only this, but the amount of steam that is exhausted is usually returned eventually to the boiler in order to avoid heating that much cold water. It is found that the apparatus required more than pays for itself in the end.

The same precautions are used, in a different way, in the gas engine. Here, owing to the very high temperature of the burning gases, it is found inadvisable, even if it were possible, to prevent the carrying away of a portion of the heat by using cooling water, or other means. Nor has it been found possible to avoid the waste of a great deal of this heat in the escape of the burned gases when exhausted. Still, considerable progress has been made within the last twenty years in reducing the losses of this character, and thereby increasing the efficiency of the gas engine.

Mr. Dugald Clerk, the noted English expert on the subject of internal combustion engines, called attention to this very matter in a lecture delivered some months ago before the Institution of Civil Engineers. He presented a table of tests of engines from 1882 to 1900, which is given on this page.

It will be seen from this that the amount of heat transformed into work has increased from 16 per cent. to about 28 per cent., and even as high as 30 per cent. has been claimed in some cases. The amount of heat lost through the water jacket has changed from slightly over 50 per cent. to a little over 24 per cent. On the other hand, the amount of heat lost through the exhaust has increased from about 30 per cent. to about 40 per cent., or even higher. While, therefore, there has been a gradual increase in the total amount of heat utilized, yet of that portion wasted there has been a change in the proportion lost in the exhaust and that lost in the cylinder cooling.

Heat Distribution.

Experimenter.	Year.	Jacket. Per cent.	Ex-haust. Per cent.	Differ-ence. Per cent.	Work. Per cent.
Slaby	1882	51	31	2	16
Thurston	1884	52	15.5	15.5	17
Society of Art Trials	1888	43.2	35.5	....	22.1
" "	1888	35.2	39.8	3.9	21.1
Capper	1892	38.9	40.5	....	22.8
Robinson	1898	33	38.3	....	28.7
Humphrey	1900	24.2	48	....	27.8
Witz	1900	52	20	....	28

What to do to utilize this wasted energy is a thing that has appealed to many a user of a gas engine, after he has learned that he must not expect to be able to prevent some waste in the operation of his engine.

In the first place, the water from a water-cooled engine usually should issue from the engine cylinder at about 160 to 190° F. in order to get the best results from the engine. If the water is kept cooler, it carries away too much heat, and the object is to keep the water as hot as possible and get efficient results. If the water is kept hotter than 200° F. it is very close to the boiling temperature, and when it turns to steam in the water jacket it ceases to prevent overheating of the engine.

This hot water is used for a number of purposes. Factory employees use it for washing purposes. Where low pressure boilers are used for heating or other service, as in steam laundries, the hot water is carried to the boiler just as the condensed water from a steam engine exhaust is returned to the boilers.

When used in hot water heating pipes the water will do more or less heating, depending on the size of the engine. In some factories, flour mills and elevators it is not necessary or desirable to maintain a very great heat, even in cold weather, for the employees are working and do not require very much heat, unless the weather is very cold. In such cases the hot water, combined with the use of the exhaust, as will be described later, will usually suffice for heating service at least the greater portion of the year, unless a very large building is used. Many small machine shops use such a system with the best of satisfaction.

In pattern shops the hot water is used to heat the glue pots. In fact, almost any requirement for a medium quantity of hot or warm water can be met by utilizing this waste water from the engine.

Of course, where a water tank is used it is often not advisable to use the water for the reason that by returning it to the tank it reaches the engine again before getting as cold as fresh water would be, and there is less heat carried away than if only cold water entered the cylinder. But in such cases the water may still be used for heating purposes by passing it through radiating pipes before returning to the supply tank.

The exhaust gases from the engine may also be utilized in heating service by passing the hot water pipes through the exhaust pot, or muffler, close to the engine. In such

cases the pot, or muffler, must be of sufficient size to permit a free escape of the burned gases without excessive back pressure. In other words, if the usual exhaust pot is of the proper dimensions to permit of easy escape of the exhaust, the insertion of a number of hot water pipes might so reduce the cubical contents of the exhaust pot as to be equivalent to using too small a pot, resulting in back pressure and its accompanying difficulties.

One of the common uses of the exhaust gases in regions where low-grade liquid fuels, such as crude oil, are used is to pass the exhaust through the generator, and thereby furnish the necessary heat to assist in the vaporization of the fuel.

In some cases it has been found advantageous to use heated air, or warm air, in very cold weather, and at least one engine company has supplied a three-way valve whereby cold air, hot air, or both cold and hot air may be drawn in by the engine. The air is heated by having come in contact with the exhaust pipe before reaching the valve.

There are numerous ways in which the heat usually wasted in the cooling water or the exhaust can be utilized. In fact, there is hardly a plant, where a gas or gasoline engine is in use, that does not require heat or hot water more or less of the time, and surely there is no excuse in such cases for not using what otherwise becomes a waste. By the advantageous use of the heat from the engine conveniences may often be devised as well as effecting a saving of money otherwise made necessary.—Albert Strittmatter, in The Gas Engine.

INDUSTRIAL NOTES.

Listowel, Ont., will erect a library building at a cost of $10,000.

R. Gillis' woodworking factory, at Sydney, N.S., which was destroyed by fire in August, is again running.

The first blast furnace of the Nova Scotia Steel and Coal Co., at Sydney Mines, was blown in on August 30th.

The Soo eel plant resumed operations on August 23rd, and is now making steel rails at the rate of 500 tons per day.

The Dominion Atlantic Railway intend erecting a 200-room hotel, at Digby, N.S., to be ready for next year's tourist travel.

The Nipissing Foundry and Machine Co. are erecting a machine shop, 25 by 40 feet, and a foundry 35 by 50 feet, in North Bay.

Oil is being struck in several new wells in Moore Township, Lambton County, Ont. Over twenty drilling rigs are at work in the field.

The compounding department of the Canadian General Electric Co.'s works, at Peterborough, was gutted by fire on September 2nd.

The Art Metal Co., of Galt, is beginning the manufacture of metal shingles and sidings. This is the fourth company in Ontario making these goods.

Arrangements are being made to put the Canada Cabinet Co., of Gananoque, again on a business footing. The company has been shown to be solvent.

The Government is paying steel bounties to firms at the Soo, Sydney, Hamilton, Midland, Deseronto, Radnor, Drummondville, and some minor places. The rate is now $2.75 per ton.

On October 4th, Waterloo is to vote on a by-law granting a loan of $16,000 to the Canada Furniture Manufacturers, to enable them to rebuild their factory in that town, recently destroyed by fire.

The Imperial Dry Dock Co., of St. John, propose erecting a large dry dock at that city. The company expects to receive subsidies from the Dominion and Provincial Governments and from St. John.

Clark & Demill, of Galt, manufacturers of woodworking machinery, may move to Hespeler. The business is growing too large for the present premises, and Hespeler is offering the inducement of a $15,000 loan. A by-law ratifying the offer will shortly be put to a vote.

The Edmonton, N.W.T., Brewing and Malting Co. has ordered from Chicago an outfit of machinery for a new malting house.

The puddlers and rollers in the Hamilton Steel and Iron Company's works have struck against a reduction of 7[illegible] in their wages.

The peat plant at Caledonia Springs, Ont., erected by Alex. Dobson, of Beaverton, is almost completed. It is the largest plant yet erected in Canada.

The Ontario Lantern Co., Hamilton, suffered by fire to the extent of about $10,000 last month. A wing of the building was gutted and some valuable machinery damaged.

Fairbanks, Morse & Co. are looking for a location for a Canadian branch factory. F. H. Crane, their representative, was well impressed with Fort William as a site.

The Dominion Iron and Steel Co. have started blowing in their blast furnaces, which have been idle since the strike in the summer. They expect to have all four working by Oct. 1st.

The Toledo Stock Company, which manufactures shovels and kindred hardware, is contemplating a Canadian branch employing about 150 hands, to be located probably at Hamilton.

The Guelph Axle Works have added a spring making plant to their equipment, and will be known in future as the Guelph Spring and Axle Co. The new building is 120 by 40 feet, and equipped throughout with high-class machinery.

There will be over 400 individual claimants for the bounty on crude oil of 1½ cents per gallon. There are some 2,000 producing wells in Ontario, but many groups of these are owned by companies.

The five woolen mills properties of the Canada Woolen Mills, Limited, have been purchased by Wm. D. Long, of Long & Bisby, wool dealers, Hamilton, for $253,000. The mills will be reorganized under new management.

Malcolm Booth, a Yale graduate at Yarmouth, N.S., has developed a peat process, by which the raw material is dried, compressed, and coked. Tests of the peat coke have been made at the Yarmouth Street Railway Co.'s power house, and on one of the naval launches at Halifax, and reports show the fuel to be a steam producer equal to, or better, than Welsh coal.

The J. A. Craig Lubricant Co., Limited, of Toronto, to whom a charter has recently been granted, are putting on the market an improvement in oil and grease compounding which they believe will revolutionize the business. They have testimonials from some large manufacturers and mill men as to reduction in lubricating accounts by fully one-half, by the use of this compound.

The introduction of the $7 duty on steel rails has led to the revival of the rumor that the United States Steel Corporation is collecting data as to the feasibility of establishing a plant in Canada. The plant, if established, would include a steel rail mill, blast furnaces, and finishing department, and would cost about $12,000,000.

Heavy rains raised the water in the Chaudiere almost to the level of spring freshets, and the temporary works erected across the river and the coffer dam and machinery in connection with the railway bridge under construction were swept away on September 4th. This bridge was part of the work of the Quebec Bridge Company, and was intended to connect the railway lines east of the Chaudiere with the main bridge across the St. Lawrence river. The loss to the contractors will be heavy, as it practically destroys their summer's work at that point.

The first meeting of the Northern Iron and Steel Company, Limited, successors to the Cramp Steel Company, Limited, of Collingwood, was held in Toronto on the 22nd ult. The following officers were elected for the new company: Major J. A. Currie, president; Duncan Donald, secretary-treasurer; F. Asa Hall, J. T. Duguid and W. J. Lindsay, directors. The rolling mills, steel furnaces and other plant will be formally turned over to the new corporation at once.

—The first autumn session of the Canadian Society of Civil Engineers will take place on the evening of the 13th inst. at the Society's rooms, in Montreal.

MINING MATTERS.

A discovery of gold is reported from Shelburne, Ont.

Two new iron zones are reported in McTavish Township, New Ontario.

Two Melbourne inventors claim to have a process for producing steel from ore without making pig iron.

C. A. Millican, C.E., has been making surveys for a branch line to the gypsum beds of the Little Saskatchewan.

Rich strikes of copper sulphide ore have been made at Franklin Camp, forty-five miles north of Grand Forks, B.C.

An ore consisting of a mixture of specular red hematite and brown hematite, averaging 64 per cent., is being mined at Barrasois, N.S.

A large mica mine, near Cantley, Ont., owned by J. D. King, has been sold to the Westinghouse Co., of Pittsburg, who will begin extensive operations.

The Nova Scotia Steel and Coal Co. will begin mining dolomite in the George's river district, the product to be shipped to the steel works at Sydney Mines.

The coal mine, at Cochran's Lake, C.B., is now being worked by English capitalists. Mining operations are being pushed, and the quality of the coal is improving as the work proceeds.

The joint committee inspecting geological formations in Michigan and New Ontario on behalf of the United States and Ontario Governments have agreed on a common nomenclature for various formations.

The Government bounty on lead is developing that industry in Eastern Canada. A smelter has been erected at Bannockburn, Ont., and the owners are prepared to compete with British Columbia producers for the Canadian market.

A deposit of tin over a mile in length, and from 50 to 100 feet wide, is reported to have been located in eastern Manitoba, south of Cross Lake, about twelve miles from the Ontario boundary line. This is the first tin discovered in Canada.

The Black-Donald graphite mine, near Calabogie, Ont., which was flooded two years ago, is being pumped out by the Globe Refining Co. The company has a factory containing $250,000 worth of machinery, and water-power capable of developing 1,000-h.p.

Deposits of zinc in the vicinity of Quatsino Sound, B.C., have been investigated by a representative of the Lanyon Zinc Co., of Iola, Kansas. Some samples from the deposits run 50 per cent. in zinc. It is thought that the company will develop the property, shipping the ore to their works in Kansas.

One of the Montana smelting companies is now putting up an electrical smelter, and if successful, others will probably follow the example. Thus the market for coke in that region will be reduced, but the Crow's Nest Pass Coal Co., whose coke ovens are 600 miles from these works, are laying plans to supply a share of the Montana market, which requires several hundred tons a day.

Under the auspices of the Provincial Bureau of Mines, a summer mining class for the benefit of the prospectors and miners, was held at the camp of the Laurentian Mining Co., near Gold Rock. The instructors were: Professor W. L. Goodwin, director of the School of Mining, Kingston, and J. Walter Bain, a graduate of the School of Practical Science, Toronto.

The Big Master Mining Co., operating near Gold Rock, Rainy River district, has been incorporated in New York, with a capital of $300,000. The provisional directors are: F. J. Kendrick, of Mount Clemens, Mich.; C. P. Russell, of Cincinnati, Ohio; B. Hammond, of Fishkill; W. Schaler, of Albany; and G. V. Blackstone, Jamestown, N.Y. The offices are at Fishkill, N.Y. The mine has been worked intermittently since the fall of 1902, and produces ore worth about $8 per ton.

Different deputations of marine experts have examined the Turbinia during the summer, and the results in every case have been most satisfactory. A board of naval engineers from the United States have examined the boat, and will advise the use of turbine engines in scout ships.

RAILWAY NOTES

The Pressed Steel Car Co. will erect a shop in Montreal.

The Pere Marquette shops in St. Thomas are approaching completion.

Construction has commenced near Richmond Hill at the Toronto end of the James' Bay Railway.

A company is about to instal automobile stage lines in New York City, in competition with the street railway systems. A three-cent fare will be charged.

The Canadian Pacific has leased for 999 years a twenty-one mile line of the Northern Colonization Co., terminating at Nominingue, Que.

The Toronto and Mimico Railway is to run through Lorne Park, subject to certain conditions relative to speed, crossings, and automatic signals.

Negotiations are in progress for the construction of a railway in Southeast Kootenay, B.C., to open up the coal lands on the Flathead river.

As forecast in the Canadian Engineer recently, the Canada Atlantic has now passed into the control of the Grand Trunk Railway, to be used in connection with the transcontinental system.

The passenger rolling stock of the Pere Marquette Railway, on the London and Port Stanley line, will be renewed before next summer. The condition of the present cars has been the subject of complaints from the city of London, the owner of the line.

The Interborough Rapid Transit Co., of New York, will equip all elevated trains with a controller such that with the removal of pressure on the handle, power will be shut off and the brakes set. The object is to avoid danger in the case of a motorman's sudden death or his falling asleep.

The Locomotive and Machine Company, of Montreal, have turned out the first two large locomotives for the Grand Trunk Railway. The railway had their own engineers superintending the entire construction of the engines, and in taking them over expressed entire satisfaction.

The Ontario Railway Taxation Commission met representatives of the railways on September 16th, when Chairman Pettypiece intimated that the companies will be expected to contribute $2,000,000 in provincial taxes. Statements by the railways will be presented at a meeting to be held on October 8th.

The New Brunswick Southern Railway are about to improve the metal bridges of their system. Contracts for steel structures for the crossings at Meadow Brook, Lepreau, Big New River, and Lilly Brook have just been closed with the Dominion Bridge Company, of Montreal, and the shop inspection work placed in charge of the DeLano-Osborn Engineering Co., of Toronto.

On September 1st, the Hamilton street railway ,withdrew the scale of limited (8 for 25c.) tickets to any but "workingmen," and also stopped the sale of such tickets on the cars. The city has applied to the courts for an interpretation of its contract with the company. The court has ordered the sale of the tickets on the cars, but the question of discrimination of passengers is left to the trial judge.

The Canadian Northern has filed plans for its proposed air line from Hartney to Regina. The line, which is 198 miles long, will cross the Manitoba boundary into the Territories on section 1, township 10, range 30 west, and will run in an almost air line northwest to Regina, about midway between the C.P.R. main line and the Arcola branch. It will pass through or near the post offices of Kissina, Montgomery, Montmartre and Hicksvale.

Some of our railroads are reported to be working a scheme by which they will comply with the letter of the law and yet avoid the duty on steel rails. They are getting in large shipments this month, and will lay these rails on their main lines in substitution of the present ones, which will be set aside for use on branches and extensions. The law states that rails bought before the passage of the order-in-council, imported before November 1st, and laid before February 1st, are exempt from the new duty.

Construction work is beginning on the Klondyke Mines Railway, recently financed in London, England, by E. C. Hawkins, formerly manager of the White Pass and Yukon Railway.

H. Osborne has been appointed general superintendent of the new Angus shops of the C.P.R. in Montreal. At the same time, the position of master mechanic of the Delorimier shops has been abolished.

About 3,000 men are now employed on the main line of the C.N.R. from South Saskatchewan to Edmonton, a distance of 400 miles. The track layers are near Clark's Crossing, and by winter it is expected that grading will be finished to within 75 miles of Edmonton.

Hon. Charles D. Haines, of Kniderbrook, N.Y., has been in conference with the Wentworth county council regarding his project for an electric railway between Hamilton and Brantford. He does not ask for a bonus, and he is willing to put up one-third of the $300,000 required to equip the road. Ten cars would be run each way per day, and the fare would be 25 cents.

After the banquet of the Canadian Manufacturers' Association, at Montreal, last month, a special train was made up by the Grand Trunk for Toronto. Starting at 2 a.m., the train made the distance to Toronto, 333 miles, in five hours and ten minutes, the fastest time ever made between these two cities. A few years ago twelve hours was the express train time between Montreal and Toronto.

The first annual meeting of the Brockville, Westport and Northwestern Railway Company was held last month at Brockville. The president, John Gerkin, of New York, urged the extension of the road beyond Westport, and a committee was empowered to take action. The following officers were elected: John Gerkin, New York, president; Clarence P. King, Philadelphia, vice-president; Sarsten Heilshorn, New York, secretary; W. J. Curle, Brockville, superintendent.

While the railroad world is discussing the various projects of J. J. Hill to secure new feeders for his Great Northern line from Canadian territory, no attention has been paid to the work done in southern Alberta. The line from Lethbridge to Coutts, with its westward extension to Cardston, is being considerably improved, and the narrow gauge railway is being transformed into a standard gauge. Parties of surveyors are locating a line to the Crow's Nest Pass, which would meet the Hill lines in British Columbia, at Fernie. At the rate of construction, this link will be completed next year, and then the coal and other minerals of the Kootenay will have an eastern outlet to the American frontier, which will be shorter to reach the markets of Montana, Dakota, Nebraska, and Iowa. At the present time, the coal of the Kootenays has little chance to compete with Galt coal in southern markets, but the new line will make a great change. It should develop a great local trade between the farming section of southern Alberta and the British Columbia mines.—Winnipeg Free Press.

MARINE NEWS.

Steamer Viking, from Halifax, for Hamilton Inlet, Labrador, went ashore near Belle Isle.

The Hazel Dollar Steamship Co. has been incorporated in British Columbia, with a capital of $200,000.

Canadian Lines, Limited, has inaugurated a direct steamship service between Canada and France.

It is reported that the Turbine Steamship Co. will next season put a second turbine boat in commission on Lake Ontario.

The Dominion Atlantic Railway intend establishing a line of steamers from Boston to Digby, N.S., where they are erecting a hotel.

The Russian barquentine, Neikelson, 450 tons, with salt, for Shediac, went ashore near Louisburg, C.B., on September 4th, and is a total loss.

Plans for the new lift lock at Kirkfield, on the Lake Simcoe section of the Trent Canal, will soon be complete, when tenders will be called for.

A. A. Wright, M.P., is engaging a party of men to conduct a preliminary survey of the Ottawa and Georgian Bay Canal for the Government.

A typographical error in this column last month made us say that the Dominion Coal Co. would build steamers capable of carrying 1,500,000 to 2,000,000 tons of coal. As the reader would perhaps guess, the item should have stated that this capacity is per season, not per cargo.

The Dominion Government is taking over control of certain waters in Victoria, Haliburton, Peterborough, and Hastings Counties, which act as feeders for the Trent Canal system. By the use of dams, several lakes have been converted into reservoirs, and these works will be enlarged. An agreement with the Provincial Government will protect the rights of all concerned.

The steamer Arctic (formerly Gauss), left Quebec on September 17th for a three years' cruise in northern Canadian waters. Major Moodie is commander-in-chief of the expedition, Inspector Pelletier is head officer of the Mounted Police detachment on board, and Capt. Bernier is sailing master. Some doubt has been expressed as to whether the Arctic will be able to reach Fullerton before the close of navigation. For the first year the Arctic will confine its explorations to Hudson Bay, Hudson Straits, Davis Strait and Baffin's Bay, and will not go further north than Kennedy Strait.

Galveston, Texas, has just completed a sea wall which, it is believed, will afford ample protection against such calamities as that which recently overtook the city. The wall is 17,593 feet long and is composed of crushed granite and cement, well mixed, and formed into one solid rock 17 feet high above mean low tide—16 feet wide at the base, curving in on the gulf side to 5 feet in width at the top. It is firmly founded on piling driven 40 feet to clay, with an extra row of sheet piling along the front and a rip-rap of huge granite boulders in front extending 27 feet out in the gulf. The contract price of the wall was $1,198,318.

The fisheries protection cruiser, Vigilant, for service on the Great Lakes, was launched at the Polson Iron Works on September 3rd. The Vigilant is 176 ft. on the waterline, 22 ft. beam and 14 ft. 3 in. deep. Her engines are twin-screw, triple-expansion, 13½, 22 and 36 in. cylinder diameters by 21 in. stroke. Steam is supplied from two Clyde boilers 11 ft. 6 in. in diameter by 12 ft. 8 in. long, allowed a working pressure of 200 lbs. The propellers are of Thornycroft construction. Her armament will consist of four rapid-fire guns. The steamer has a flush main deck and bulkheads with a ram bow and elliptical stern of a design similar to the cruisers in the British navy. She has a commodious deck house aft of the foremast containing chart room and gallery, and also a deck house abaft the main mast. The bridge extends from the forward deck house to the ship's side. The vessel is schooner rigged with jib, head, foresail, and mainsail. She has a complete installation of auxiliary gear including steam steering gear, steam windlass for working the anchors, electric engines and dynamos and a powerful searchlight. Her cost complete will be about $150,000.

Hon. Chas. Hyman, Acting Minister of Public Works, has made the following appointments on the surveys along the route of the proposed Ottawa and Georgian Bay Canal from North Bay to Montreal. The chief engineer will be E. D. Lafleur, and the engineer in charge A. St. Laurent. The divisional engineers will be: Nipissing Division, J. Chaplean, Ottawa; Ottawa Division, F. J. Ramboth, Quebec; Montreal Division, Geo. P. Brophy, Ottawa. The following will be sectional engineers: F. F. Perrault, North Bay; Wm. Cross, Toronto Junction; C. F. McNaughton, Montreal; L. R. Voligny, Ottawa; H. P. Bell, Victoria, B.C.; A. C. MacDougall, Ottawa; Geo. L. Griffith, Winnipeg; A. Robert, Ottawa. The following are first assistants to the sectional engineers: F. A. Forward, Iroquois; A. J. McDougall, Cornwall; J. H. Armstrong, St. Catharines; C. R. Coutlee, New Glasgow, N.S.; A. L. Ghysens, Montreal; Mr. Jennings, Toronto; R. H. Barrett, Pembroke. The following are second assistants: C. H. Mathewson, London; F. H. Pense, Kingston; A. Birch, Westmount, Que.; S. Ouimet, St. Rose, Que.; F. R. Smith, Chatham; F. G. Goodspeed, Penniac, N.B.; P. Davis, Windsor, Ont.; Henry Robertson, Montmagny, Que.; Edgar Miles, Fredericton, N.B.

The Niagara Navigation Co., which has had very trifling losses by accident in the past few seasons, had its first mishap this summer on the 26th ult., when the Chicora had a piston-rod broken and a cylinder head stove in. The damage was estimated at $10,000 to $15,000. The Chippewa, which was laid up for the season, has been put on the route to take the Chicora's place. Through the prompt work of the engineer, the disabled steamer was brought into Toronto under her own steam.

MUNICIPAL WORKS, ETC.

Montreal is to establish a municipal insurance fund.

Whitby has recently purchased its electric light plant.

The city engineer of Ottawa has recommended an improvement in the waterworks amounting to about $7,000.

Wentworth County has bought the last toll road in the district, the Barton street road. The price paid was $6,000.

The Waterous Engine Works Co., of Brantford, have been awarded the contract for two fire engines at $13,440 each for the city of Toronto.

The Allis-Chambers-Bullock Co. has the contract for the pumps for the Medicine Hat waterworks. These will be installed before December 15th.

A special committee on renaming and renumbering Toronto's streets has decided on a block plan, and will recommend a by-law to permit of the work being proceeded with at once.

A system of waterworks and sewage is being rapidly constructed at Lethbridge, N.W.T. The town also has a system of irrigation ditches used for watering trees, lawns and gardens.

Hamilton has just put its new James street reservoir in commission. The reservoir is 240 feet above lake level, and has a capacity of two and a half million gallons. The sides and bottom are constructed of concrete.

A C.P.R. official has been in Morden, Man., looking over the ground with a view to placing a long distance telephone on their line, which would be operated in connection with a municipal telephone system in the town.

St. Thomas intends to purchase the gas and electric plants from the operating company. The offer of the city has been refused and arbitrators have been appointed. T. W. Curry is arbitrator for the city, Judge Morgan for the company, and Judge Snider the third arbitrator.

The Toronto delegation, which visited various United States cities, investigating fire-fighting appliances, has returned and presented its report which calls for a separate water-main system in the business part of the city; the purchase of a fire-boat, and three 750-gallon steam fire engines and an addition of fifty men to the fire brigade.

St. Thomas has managed its own street railway for nearly two years. Last year the road just paid its way, and this year there will be a small surplus, which would have been very much larger if last winter had not been so severe. eight tickets are sold for twenty-five cents, and limited tickets ten for a quarter. It is proposed to extend the line to Port Stanley.

The Ontario Municipal Association met in Toronto on September 8th. Among other business they passed a resolution favoring Government purchase of trunk telephone lines, and approved a scheme for a Dominion Municipal Insurance Corporation. Officers were elected as follows: Mayor W. A. Boys, of Barrie, president; Mayor Greer, of Owen Sound; Controller Hubbard, and the Mayor of Belleville, vice-presidents, and S. H. Kent, Hamilton, secretary.

The Montreal Gas Co.'s franchise expires in May, 1905, at which time the city has the option to purchase the plant at a price to be fixed by the experts, provided six months' notice is given, failing which, the franchise continues for five years. The city council will probably introduce a by-law shortly, and submit it to the ratepayers, so as to be able to give notice before November 1st. Prices of gas are now $1.20 per thousand for illuminating, and $1 for cooking.

Oshawa has begun the construction of a waterworks system.

Newton Ker, city engineer of Ottawa, was recently offered the position of engineer on the G.T.P., between Winnipeg and Lake Nepigon, but the city council retained him by increasing his salary to $3,800, with an annual increase up to $4,000 should he remain in the city's employ.

The reclamation of the drowned lands in Osgoode Township, Carleton County, is progressing steadily. The work of dredging Castor river, which covers an extent of about fourteen miles, is about half completed. By the dredging of the Castor the water is allowed to return to its natural channel, and hundreds of acres of land are being reclaimed for cultivation.

In a report to council, a few days ago, George Janin, superintendent of the Montreal Waterworks, stated that a new battery of three Caldwell boilers, recently ordered by the city, is being built. These boilers are destined to replace the condemned battery of three Lancashire boilers and to supplement the work of the other boilers, when the turbine pumping decreases. The pumps at the low level station raise the water up to the main reservoir of the city, situated at an altitude of 204 feet above the river, and 165 feet above the intake basin of the low level pumping station. A building erected on the land adjoining the above mentioned reservoir contains the high level pumping machines, which consist of two pumps operated by steam. A Worthington power pump, worked by electricity, which has been recently added, is prohibited from being used at present by an order of the court, on account of the inconveniences of the neighborhood from its vibrations. An arrangement is likely to be arrived at whereby the electric pump will be moved to the wheel house.

Regina, the capital of the North-West Territories, which two years ago contained 2,500 inhabitants, now has a population of 7,000. In 1902 that city collected taxes on a valuation of $998,000. In 1903 it had grown to $1,024,966, and in 1904 the taxable value of the real estate within the city limits amounted to the sum of $1,872,630. The value of new buildings erected during the present year amount to no less than $311,730. The city is putting in an electric light plant, the power house of which is now finished. The system will be ready for operation about the end of the year. A water and sewage system is also being installed at a cost of over $15,000. It is a gravitation system, the source being a stream in a series of hills about seven miles distant. This source, which was recommended by John Galt, of Toronto, the designer of the system, although criticized locally, has turned out far better than anticipated both in quantity and quality. The water system will be complete by the new year, and work on the sewage system will be begun in the spring. All these utilities are owned by the municipality. The Arcola extension of the C.P.R. will be opened up for traffic in October, thus bringing another very rich section of country into touch with Regina. The completion of the Canadian Northern Railway, from Hartney to Regina, will make Regina an important railway centre.

TELEPHONE AND TELEGRAPH.

The Grand Trunk Railway has put in a telephone line between Palmerston and Owen Sound and Wiarton. The same wire is used for telegraphing.

Since the decision of the Brantford City Council to instal a municipal telephone plant, the Stark Telephone, Light and Power System, Limited, of Toronto, has sent in a revised offer, which has led to the council rescinding the by-law for municipal ownership, and the city will receive tenders for a franchise until October 18th. The Stark Co., in their offer, agree not to sell to or amalgamate with the Bell Telephone Co. or their successors.

The light and telephone system of the Stark Co. is now being installed in Toronto Junction. The first two stations were put into operation on September 30th This is the first public system using an automatic system to operate in Canada.

The Pittsburg Railway Co. is experimenting with telephones in street cars.

The town of Neepawa, Manitoba, is practically doubling its public service telephone system by rebuilding its line construction, putting in a large amount of lead-covered cables in its main leads and putting in an enlarged self-restoring drop central office equipment. The construction work and installation is being done under the supervision of J. A. Gordon, of the International Telephone Mfg. Co., Chicago.

A Marconi wireless telegraph station is to be erected immediately at Cape Ray, Nfld. Cape Race will then be similarly guarded, and it is expected that these two stations will be finished by the end of October. It is intended also to have stations at Sable Island and Canso before winter. The St. Lawrence stations will be closed for the winter.

The American De Forest Wireless Telegraph Co. has recently purchased abandoned Marconi stations in Chicago, and in Havana, Cuba. The De Forest Co. claim to have a perfectly satisfactory tuning device, thus solving one of the greatest problems of wireless communication. Ten stations on the St. Louis Fair grounds are working satisfactorily, and recently an overland record was made when messages were sent from St. Louis to Chicago, a distance of over 300 miles. In the United States the De Forest system seems to be proving superior to the Marconi system, and large holders of Marconi stock appear anxious to unload.

LIGHT, HEAT, POWER, ETC.

Natural gas was struck at Highland Creek, Ont., recently.

The Canadian Westinghouse Co. has located its Winnipeg offices, which will be in the new Union Bank building, the first of Wininpeg's sky-scrapers.

A company has purchased the water power in the Gaspereaux River, N.S., and proposes to furnish light to the entire western peninsula of the Province.

St. Andrew's and Carillon, Argenteuil County, Quebec, are to have electric light. The power is taken from the North River at Isle au Chats, west channel, and is being carried out by the Selby Company, of Montreal.

A power house for the Berlin and Waterloo Street Railway Co. is to be completed by December 1st. The main building will be 88 x 30 and the boiler-house 30 x 40. The plant will have a capacity of about 200 horse-power.

The North Bay electric light plant, owned by John Bourke, has been sold to a syndicate of which A. F. Leggatt, president of the North Bay Gas Co., is the representative. The company will control the gas and electric lighting business of the town.

M. P. Davis is duplicating the machinery in the power house at Cornwall, Ont. This will give a total of 2,000 horse-power, which will allow for the new demands which will be made when the new paper mill and new cotton mill are running.

The Woodstock Railway, Electric Light and Power Co., of Woodstock, N.B., is constructing a wood and concrete power dam, about two miles from that town, on the Meduxnakitt river. The dam is 420 feet from bank to bank with a 175-foot spillway, 25 feet above low water. 500-h.p. will be developed. Work was begun in June and the company expects to deliver power by December.

The Canadian Westinghouse Company, Limited, of Hamilton, Canada, have opened offices in Winnipeg, Man. The offices are located in the Union Bank Building. The representative in charge of the district covered by this office is W. E. Skinner, who was formerly associated with the Westinghouse Electric and Manufacturing Company, of Pittsburg, Pa.

The American Conduit Company, Manhattan Building, Chicago, has been awarded a contract by the Electrical Commission of Baltimore to furnish that city with 200,000 feet of bituminized fibre conduit. This contract was awarded after a series of exhaustive tests and investigations, and thus forms another link in the chain of evidence favorable to bituminized fibre conduit for underground construction.

On the 9th ult. one of the large generators of the Toronto Railway Co., costing nearly $40,000, was burnt out. The short-circuiting of some of the underground wires was reported to be the cause.

On the 14th ult. contracts were awarded for the power distributing station to be erected for the Toronto and Niagara Power Company on the Davenport road, just outside the city limits of Toronto. The cost will be slightly over [illegible], the building to be completed in a year. Among the successful tenderers were: E. Gearing, for brick, stone, cement, carpenter and cut stone work; J. Gillen, the galvanized iron work; the Canada Foundry Company, the steel and iron work.

In order to handle their rapidly increasing business, the Packard Electrical Company, Limited, of St. Catharines, Ont., have recently organized and greatly enlarged their Sales Department, the management of which has been given to George C. Rough, formerly manager of the eastern office in Montreal. Cecil Doutre, who is favorably known to the electrical trade, will look after the interests of the company in the East, occupying the place vacated by Mr. Rough. The Ontario district will be covered by J. M. Leamy, formerly with the Westinghouse Company. George A. Powell will continue to look after the important Western territory, as manager of the Western office in Winnipeg. L. R. Grimshaw will prove an invaluable addition to the office end of the Sales Department, at St. Catharines.

PERSONAL.

James Bannan, engineer at Toronto City Hall, has been elected fourth vice-president of the International Union of Steam Engineers.

Patrick Fitzpatrick, for fifty years lockmaster on the Lachine Canal, died last month at the age of 73. He succeeded his father as lockmaster.

L. B. McFarland, of Montreal, was elected to the Executive Committee of the Old Time Telegraphers' Association, at a convention held in Atlanta, Ga.

A. Price, C.P.R. superintendent of Fort William, formerly of Toronto, has been appointed superintendent of transportation of the western lines, with headquarters at Winnipeg.

R. C. Carter, general manager of the Bay of Quinte Railway, the Oshawa Railway, Thousand Island Railway, and the Deseronto Navigation Company, died of paralysis a few weeks ago.

William King, late general storekeeper of the Dominion Iron and Steel Co., is now superintendent of the American Asbestos and Mining Company, Black Lake, P.Q., in which Henry M. Whitney is interested.

Clark Caryl Haskins, well-known in the electrical world as writer and inventor, is dead. His most notable achievement was evolving the multiple switchboard, now used for telephones all over the world.

John Stewart, of Woodstock, N.B., died on September 6th. Mr. Stewart became superintendent of the New Brunswick Railway System in 1882, and in 1890, when the C.P.R. took over the system, he was made superintendent of the Northern Division.

There is an agitation in Montreal to erect a memorial to John Young, the father of the St. Lawrence canal system and several other public works. He inaugurated the Victoria Bridge, and the subsidizing of the line from Montreal to Liverpool, and his efforts had much to do with the inception of the Intercolonial Railway and the holding of the London Exhibition of 1851. In 1851, Mr. Young held the portfolio of Commissioner of Public Works.

A. McPhail, B.Sc., has been appointed professor of general engineering, and W. O. Tague lecturer in mechanical engineering in the School of Mining, Kingston. Mr. McPhail graduated from McGill University with honors. He has recently been engaged in large engineering works in the vicinity of Boston. Mr. Tague is a graduate of the Massachusetts Institute of Technology. After his graduation he spent a summer abroad, visiting large manufacturing concerns and foreign shipyards. He has been recently employed by the New York Shipbuilding Co. and Fore River Shipbuilding Co., Quincy, Mass.

Wm. Irving, a former city engineer of Kingston, Ont., died a few days ago at Riverside, California.

Charles Brandeis, electrical and mechanical engineer, of Montreal, has moved into more spacious offices in the Guardian Building.

E. J. Pennington, inventor, and promoter of automobile, air ship, and other companies with big claims, was recently arrested in St. Louis for conspiracy and fraud. Last year he visited Toronto and claiming to have millions behind him, attempted to exploit a company, but was not successful.

Dr. Hans Goldschmidt, inventor of Thermit, for which Wm. Abbott, of Montreal, is the Canadian agent, will visit the United States, as delegate of the Bunsen Society, and as such will attend the International Electrical Congress at St. Louis. A lecture with numerous demonstrations on his invention, Alumino-Thermics, will be one of the features of the congress.

J. H. McClellan, of Peterborough, has been appointed superintendent of the Trent Valley Canal. Mr. McClellan ran for Parliament at the last election, and is one of the most prominent business men in the Trent Valley. He was at one time manager for the Dominion Bank, and entered commercial life as a grain merchant. He afterwards built Pickering harbor, and conducted a large grain buying and shipping business there until he removed to the City of Peterborough. He was the managing director of the Peterborough Fuel and Cartage Co.

R. L. Newman, of New York, has taken a position as consulting engineer for the Victoria Machinery Depot, Victoria, B.C. Mr. Newman is a shipbuilder of wide experience, having at various times been with John Penn & Sons, Greenwich, Earl's Shipbuilding Co., Hull; Mandsley Sons & Field, London; Cramp Shipbuilding Co., N.J., and the American Shipbuilding Co., Cleveland. He has recently been general manager for the New York Shipbuilding Co., of Camden, N.J. Mr. Newman has worked on the designing and construction of ships for the navies of England, Italy, Spain, United States, Russia, Peru, Brazil, and other countries.

PEAT PAPER.

The February number of the Pulp and Paper Magazine of Canada, contained an article on experiments that have been made in this country and in Ireland recently in the manufacture of paper boards from peat. Since the experimental machine set up by Mr. Dobson at Beaverton, the erection of a factory having three machines with a capacity of 30 tons of "half-stuff" per day has been started at Cannington, near the south-east shore of Lake Simcoe, and is soon to be in operation, under the auspices of the same gentleman. The report of the Ontario Bureau of Mines for 1904, recently issued, speaks encouragingly of this industry, though in view of the collapse of the experimental factory in Ireland, and the failure, commercially speaking, of experiments in this field in the Eastern States, it must be admitted that there are difficulties yet to overcome. The remarkable capacity of sphagnum—from which plant the peat beds are formed—for absorbing and retaining moisture, is one of the problems to solve; but no doubt human ingenuity will be equal to the case. As a substitute for other fibres in the making of imitation leather, as well as for paper boards, there would appear to be a distinct field for peat, and the samples used by some Canadian shoe manufacturers for the filling of boot soles and heels are said to be a great improvement over other leather substitutes. This process is the invention of an Austrian, who died this year, but the works established at Admont, Austria, for exploiting the process, are reported to be a commercial success. The cost of making boards there is given as $9 a ton, but in Ontario the cost is calculated to be $12.50 or about half the price of strawboard and less than half that of board made from wood pulp. At the works at Cannington, it is proposed to make card board, leather board, fibre board, and other lines now made from straw and wood pulp. A sample made at Beaverton is on view at the office of the Pulp and Paper Magazine, and though it is made of a mixture of peat and wood pulp, it is much stronger than ordinary board, and experts say it will make an admirable board for bookbinders' use. Canada is as wealthy in the raw material of this product as she is in pulpwood, for millions of tons of peat are to be found in various provinces, more especially in Northern Ontario and Quebec.

REMOVING METAL SPLINTERS FROM THE EYE.

The ragged chips and splinters which are separated during the processes of turning and chipping off, often find their way into the eye, and are sometimes very difficult to remove. The use of magnets has been recommended, but even the strongest magnet is entirely inefficient, if the splinters be imbedded. We have found a fine, sharp knife the best instrument, but it requires skill and a steady hand. The best method in the hands of the inexperienced is that which a London surgeon thus describes in the Lancet: "In consequence of the difficulty I experienced in removing from a patient a portion of steel deeply bedded in the cornea, which did not yield to spud or needle, some other means of removal became necessary. Dry, soft, white silk waste suggested itself to me, and was wound around a thin piece of wood so as to completely envelop its end. This soft application was brushed once backwards and forwards horizontally over the part of the cornea where the foreign substance seemed fixed. To my astonishment it was at once entangled by the delicate but strong meshes of the silk, and was withdrawn with the greatest ease, caught by the same. A gentleman in turning steel at a lathe suddenly felt that a portion had entered his eye. He went at once to a surgeon, who, with the most skilful manipulation, failed to extract the same, saying it would soon work out of itself. The next morning the patient saw me, having suffered severely since the accident, and on the first application of the silk the steel was extracted."

GRAND TRUNK PACIFIC PROGRESS.

During the past month the Grand Trunk Pacific directors have completed their trip up the Pacific Coast. They made a general inspection of the coast from the Alaskan boundary to Bute Inlet. They went up the Portland Canal some distance, and also inspected Port Simpson and Tuck's Inlet, and ascended the Skeena river as far as Hazelton. Before coming to any conclusion as to a terminus, the directorate will await the results of surveys of the land approaches.

The construction of the main line will be pushed first and later southern feeder lines will be built. The Allan Steamship Co. will in all probability inaugurate a Pacific service with the completion of the G.T.P.

The Transcontinental Railway Commission has appointed M. J. Butler assistant chief engineer to Mr. Lumsden, and has plotted out the work of surveying the line from Moncton to Lake Abitibi. This section is divided into three districts with district engineers as follows: District A, from Moncton to the boundary between New Brunswick and Quebec, Guy C. Dunn, acting district engineer; District B, from the New Brunswick boundary to Clear Lake, Quebec, A. E. Doucet, district engineer; District C, from Clear Lake to Lake Abitibi, A. N. Molesworth, district engineer.

Twenty-seven surveying parties are being organized and will be placed on the three districts immediately. They will be located as follows: Between Moncton and Chipman, two parties; Chipman to Boiestown, one party; Chipman towards Fredericton and St. John river, one party; between Boiestown and Plaster Rock, two parties; Plaster Rock to Grand Falls, one party; Grand Falls to Edmundston, one party; Edmundston to Connor, one party; Connor to Lake Pohengamook, one party; between Lake Pohengamook, which is the boundary between New Brunswick and Quebec, and to or near Chaudiere, four parties, one at each end and two in the centre; Quebec, including both sides of the proposed bridge, one party; from there on to Clear Lake, four parties, covering about 32 miles each; from Clear Lake to the boundary between Ontario and Quebec, and south of Lake Abitibi, four parties; four parties on the route running north of Lake Abitibi, and between that and the point where the southern route converges. Alternative routes will be investigated between Grand Falls and Chipman, N.B., and also north and south of Lake Abitibi. Nine of the ten engineers to take charge of survey parties in the New Brunswick district have been

selected, as follows: Charles Garden, C. Led Miles, G. R. Balloch, F. D. Maxwell, E. G. Evans, C. O. Foss, Horace Longley, N. P. Clark, Karl Weatherbe. It has been decided to secure the services of Dr. Murphy in connection with the river crossings in the province of New Brunswick.

Supplies for the survey parties in northern Quebec will be transported up the rivers. John Sunstrum will superintend this work on the Ottawa, and Allan P. McDonald on the Gatineau.

The Commission plans to have all exploratory surveys on the eastern division, that is, from Winnipeg to Moncton, completed by spring.

ON INSULATION.

It may be taken for granted that testing the insulation of an electrical machine after completion, without any previous satisfactory knowledge of the insulating materials used in its manufacture, is far from being the correct thing to do. If, then, we are to choose between the various insulating materials on the market (each of which may be good for a particular purpose), it becomes essential to institute some preliminary tests. As to what should be the nature of these tests, it would be profitable to first consider what the insulation has to do, and under what conditions. These points will determine the nature of the tests it will be profitable to make.

It will be beneficial here to note some of the conditions which have to be fulfilled by a good insulator, though it may not be absolutely necessary that one particular insulator should meet every possible condition. These conditions may be broadly divided into two classes, viz., those necessary for convenient and cheap manufacture, and those essential to the longevity or commercial efficiency of the machine.

Taking first "paints or varnishes," we find the following features desirable, if not absolutely essential: (1) They should be quick drying, and yet should not lead to great waste owing to the drying up of the solvent; (2) they should have considerable elasticity and strength; (3) have a high melting point, and should not lose their insulating properties or char with possible rises of temperature in practical use; (4) should not chemically affect the copper conductors; (5) must be waterproof and unaffected by oils, acids, and, as sometimes specified, salt water; (6) last, but not least, should be good insulators.

Secondly, with regard to insulating fibres, papers, and tapes, we know that some depend on the nature of the material for their insulating properties, whilst in others this is merely a medium for carrying an insulating "varnish or paint," and it is on this that the strength of the insulator, as such, depends. This latter class, which also includes a certain variety of tapes, should, as far as the insulating medium is concerned, with which they are impregnated fulfil the conditions enumerated above for paints and varnishes. Regarding fibres and papers in their "natural" state—i.e., not impregnated with an insulating medium—they might be approved of if they meet the following conditions: (1) They should be tough, yet pliable; (2) should not suffer excessively as insulators should they be creased; (3) they should, as far as it is possible to make them, be non-hygroscopic; (4) should be able to stand all temperatures experienced in practice without charring or reducing their insulating properties; (5) should have high insulation per mil of thickness, except where their mechanical strength is the principal consideration. It will be obvious from the varied nature of insulating materials, and also from the fact that no one material meets all conditions, that a choice has to be made of such as will best suit the varying conditions of service, both mechanically and electrically. With careful attention to this point considerable reduction in the cost of insulating materials may be effected in the manufacture of various electrical apparatus, though the cheapest insulation is not always the best.

Returning to the subject of varnishes and paints, let us look at the first of the properties required, viz., "quick drying." It will be obvious to anyone acquainted with shop methods the great saving in time and the increased output that can be obtained from a given drying stove the more "quick drying" the insulating medium is. With this object in view resource has been made to shellac, copal and resin varnishes, using alcohol as a solvent. This would not be objectionable but for the fact that when the spirit (and also the water it carries) has been dried out, the resulting solid is too brittle. This solid under vibration or due to expansion and contraction, as the winding heats up and cools down, is in time reduced to a powder, and is then, of course, useless as an insulator. Should it be a revolving portion of a machine that is insulated with these varnishes, then centrifugal force will assist in the destruction of the insulation. Oil "varnishes" are not "quick drying" unless an objectionable amount of "dryer" is introduced. A considerable amount of waste occurs where the varnish has to be painted on coils such as are inconvenient to dip. Further, all tanks used in dipping coils should be provided with covers when not in use. Even whilst in use attention has to be paid to the consistency of the material owing to constant evaporation, and "thinners" have to be added, as when used too thick more insulation is added than is required, leading to needless expense.

2. The second property claimed is that of elasticity and strength. From this point of view all mixtures, as distinct from chemical compounds, should be avoided. They are objectionable because of separation through settling. Should this be overcome by frequent stirring it is only temporary, as separation can take place after application. These mixtures are often brittle when thoroughly dry, and this considerably impairs their use. The American asphaltums, or, as they are re-christened here, varnishes, are satisfactory at first as regards elasticity, but in time become brittle.

3. If high melting point is forthcoming, coils or armatures may be satisfactorily baked. Armatures, however, running at high peripheral speeds, especially turbine armatures, throw off the varnish in which they have been dipped at comparatively low temperatures, as the high centrifugal force assists in this work. This is, of course, a great disadvantage, covering as it does the field winding and poles with a discoloring varnish. It may be noted here what temperatures may be expected under working conditions. The writer knows of one or two electric lighting stations where the temperature is not infrequently about 100 deg. F., and with the usual 70 deg. F. rise of temperature stipulated in most specifications, we get 170 deg. F. as the final temperature. This, it should be noted, is only at points convenient of reaching, and consequently internal parts of the windings will be considerably higher. It is certain, therefore, that insulating materials should not melt or have their insulating properties deteriorated under a temperature of at least 212 deg. F. Even this will probably leave no margin. Insulating materials should be tested throughout the working limits of temperature, as some lose their previously high insulating properties when the temperature is raised to the working limit, whilst the insulation in some cases chars or carbonizes. This is a very important point, as many engineers insist that pressure tests on plants must be made immediately after a lengthy full-load run, and sometimes an additional run of two hours on 20 or 30 per cent overload. The machine will, of course, be still warm and most likely warmer than at any time on load, as the cooling effect of the revolving parts has then ceased.

4. Affecting the copper winding chemically applies more particularly to varnishes, but as insulating materials are generally secret mixtures, it is not safe to say that all paints are free from this fault. If, however, care is taken to neutralize any acids, such as would attack copper and gives us the green deposit of copper sulphate, this fault is done away with. The moisture in the cotton covering of wires, not dried out before varnishing, assists in this chemical action which detroys the cotton covering, and thus leads to short-circuiting of the turns. It would be as well to mention here that cotton covering is much to be preferred to paper, which is readily cut on the edges of flat strip copper. Cotton covering should never be single, and if to be roughly handled should be braided.

5. The material should be impervious to moisture, unaffected by oils, acids, and salt water. It is, of course,

well known that water is an undesirable attendant of insulation, and therefore, there is no need to labor this point beyond mentioning the specially adverse conditions to which some outside work is subjected, as, for instance, traction motors of all descriptions, motors for small tools in shipyards, etc. Insulation should certainly not wash off within a reasonable time. Regarding oils, many machines are subjected to trouble from this cause; motors from faulty bearings, etc., and generators from this cause and, where placed between engine standards, from splashing of oil from the engine. Acids are detrimental to insulation, and more than one machine has had to be rewound owing to being subjected to the acid fumes from battery-rooms. Salt water has been added by engineers in cases of exposed stations near the coast, especially where the voltage generated is high, though in the case of low voltage it would only be a question of time if the insulation was not impervious to salt water.

6. The material should be a good insulator. This goes without saying, and if this is not forthcoming, the properties previously enumerated are of no account whatever. A thickness of insulation of .003 in. thickness should stand at least 2,000 volts alternating R.M.S. value. It is well to notice that fibrous materials dipped in insulating compound rarely add their full breakdown strength to that of the varnish, and it is as well to look upon the material as only a medium of applying the insulating varnish.

Turning now to fibrous materials (including papers and tapes), it will be obvious that where the paper, tape, etc., is used merely as a medium for carrying the insulating varnish, that the insulator should remain intact, that it should not crack on handling the tapes, etc.; consequently those insulators having the property of elasticity are invaluable for this use.

Considering the fibres in what we have called their "natural" state, the first property mentioned was pliability. This is essential from a manufacturing standpoint. A pliable material is much easier to work with than a stiff one, and results in a considerable saving of time. It is frequently found more convenient to use several layers of thin material for ease in handling. It is here that a good insulator scores over a poorer one, as fewer layers are then necessary.

In handling many fibre and paper insulators, it is almost impossible to avoid creasing the sheet, these materials being usually supplied in sheets or rolls. This brings us to the second point regarding this class of material. This creasing, whether accidental or intentional, should not materially weaken the strength of the material as an insulator. Further, creasing "fibre, presspahn, etc.", destroys the glazed surface, and this makes the material more hygroscopic, and is thus likely to reduce its insulating value. This class of insulator is naturally hygroscopic, and it is almost entirely on the glazed surface that dependence is made to keep out moisture. Care should be taken to inspect fibrous materials other than woven fabrics, as it sometimes happens that pinholes and very thin places are to be found, and at times small particles of metal, such as filing dust, are rolled into the material. Both of these faults are undesirable, the latter especially so.

4. That insulating materials should stand all temperatures likely to be experienced without charring will need no demonstration, but many of this class get brittle when subjected to even "reasonably" high temperatures, and then lose whatever merit they had as to strength, especially mechanical strength. In case of a short-circuit on a machine, the increase of temperature in the portion of the machine supplying current to the short is frequently very great; but it is certainly undesirable that this should necessitate the rewinding of a considerable portion of the machine.

(To be continued.)

A. C. vs. D. C. ARC SYSTEMS.

On page 317 will be found the concluding instalment of a paper with the above title read by W. L. McFarlane, at the recent convention of the Canadian Electrical Association. A spirited discussion followed the reading of this paper, a resume of which is given below.

At the close of his paper, Mr. McFarlane stated that the estimated costs of lights were merely nominal, and that \$15 or \$20 should be added to the figures given to get the real cost.

A. A. Dion: I was inclined to criticize this paper because some of the figures were misleading, and the saving effected by substituting A.C. for D.C. arc lamps was exaggerated. Happily, Mr. McFarlane's additional statement makes a difference. The superficial reader, however, would get the impression that arc lights could be produced at \$23 a year. As to horse-power, \$15 is too low; I do not know of power being sold for \$15 per real horse-power.

R. G. Black: Suppose you had a D.C. system and wanted to change to a 60-cycle A.C. in order to get the saving spoken of, would you have to space the lamps farther apart or closer? Would you need to raise the lamp or lower it, to get the best results? Would you be able to use the same distributing circuits or would you have to use heavier insulation and trim the trees? Would it be necessary to bring the wires close together or could we run up one street and down another, as we now do? Also, in case you have to underground, would it be necessary that the two wires be placed in one cable, or could you run one wire as in the D.C. overhead system?

W. L. McFarlane: In Montreal, we changed the circuits from open D.C. to open A.C. lamps, and the only change we made was to lower the hangers. I think by putting the wires somewhat closer together, the power factor could be increased. It certainly has been increased by taking out the spirals in the flexible leads. A power factor of 75 allows of the circuits being run as they ordinarily are. By allowing 50 lamps on the circuit, the insulation is about the same. The trees are not as detrimental to the service as with the Brush arc machines, or the G. and H. With regard to the cost of power, of course that is for 3,000-K.W. in 500 arc lamps, and it is as low as I know any place to obtain power for. It is simply a figure; I might have used 10 per cent.

R. M. Saxby: Except for the saving for carbon trimming, I don't think the difference between the two currents is very great. I kept a diary for a year for the old arc lamps, and for the same time after we changed to D.C. enclosed lamps, and I found the difference very slight. Of course, the enclosed lamp is a far nicer lamp than the open arc, because of the absence of the dark shadow. Does Mr. McFarlane mean there is a saving of \$6 in labor, or power?

Mr. McFarlane: A good deal of that is a saving in power. That includes everything. One has advantages in one respect, and the other in others. You can work out those costs, for any system you have you do not need to take the cost I put down.

President Wright: The point about the cost of power is rather unfortunate, as it is liable to lead to misunderstandings. The cost of power depends entirely on conditions.

Mr. Angus: We changed our system from D.C. open arc to A.C. closed arc, and had a great deal of trouble through induction on the city fire alarm and telephone systems. After doubling back the circuit on itself, we removed a great deal of this trouble. What is Mr. McFarlane's experience as to that particular effect?

Mr. McFarlane: It may be possible that in Montreal we have so many wires that it does not affect the telephone to the same extent. There was only one occasion where it was necessary to change for the telephone system. If we had a ground on our circuits, we heard from the telephone people, but apart from that, we were not compelled to parallel our lines on their account, with one exception, in an isolated suburb. The power factor of 75 is allowing for the old conditions. There may be conditions which would compel them to be run closely together. If so, perhaps 80 per cent. may be obtained.

J. G. Archibald: We did not change our system whatever. We found a little trouble with the circuits cutting out, but after we trimmed the trees there was no trouble. At the time about half the telephones were on the old ground return. They are now on metallic circuit and there is no trouble. The sidewalks are much better illuminated than they were; the light is better diffused under the trees. We are saving one man's wages in the cost of trimming lights.

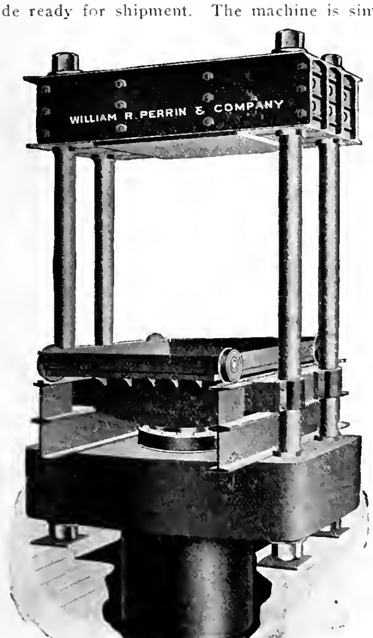
MECHANICAL WOOD PULP.*

By Stanislas Gagne, B.A.Sc.

(Continued from last issue.)

Wet and Dry Pulp.

We have seen that pulp when baled contains from 45 to 55 per cent. of water, 50 per cent. being somewhat a standard in most cases. When pulp has to be hauled only a short distance this percentage of water is not a very serious difficulty, as the freight charges are small, and the pulp can be more easily reduced to a solution again, but this is not the case when it has to be carried a long distance. Mills situated near seaports, such as those in Quebec and the Maritime Provinces, can still afford to export 50 per cent. of water with their pulp, but such a plan is ruinous to those situated more inland; hence, with longer railway transportation. This is the reason why some United States paper mills can import their wood sawn and barked instead of moving the pulp mills to the forests and railing their pulp to the paper mill. We have also seen that the percentage of water or pulp is a source of dispute, and that we must use heat to reduce it below 45 per cent. One of the largest mills in Canada has been turning out mechanically-dried pulp with a machine whose principle is illustrated by Fig. 38. The first part is the same as an ordinary wet machine with felt press rolls, etc., but the pulp, instead of collecting around one of the press rolls is taken up by another felt and carried to a roll and a large drum heated by steam, around which drum the sheet of pulp from the felt is made to pass, and is rolled up on a spindle at the other side ready for shipment. The machine is simple and



Heavy Duty Press, with working pressure of 450 tons, manufactured by Wm. R. Perrin & Co., Ltd., Toronto.

works economically, but the difficulty is to keep that single drum at such a temperature that it will dry the pulp without burning or scorching it. To prevent this tendency to scorching in a single drum, machines with several drying drums have been tried without very much success. In a word, we may say that heretofore most of the mechanical methods of drying pulp have not been a success, and that there is much room for improvement. The only method giving perfect results is by means of hot air, to which the pulp sheets are exposed, and this method is not employed in America. Many mills in Scandinavia have adopted it, and find profit by so doing. Its principle is this: Pulp sheets are hung on racks and made to pass through a chamber, at one end of which hot air is inserted, and after being exposed for some time to that hot air they come out dried. This is achieved by two processes — the tower and

Baling Press, manufactured by Wm. R. Perrin & Co., Ltd., Toronto.

the chamber processes. Fig. 39 represents the tower process. The pulp sheets are hung on racks, represented in Figs. 40 and 41, until the rack is full, when each end is connected to a long linked chain at A, from whence it goes up B, comes down C, and goes out at D dry. Air is heated at E, goes up C, down B to a fan F, and back to E, where it is reheated. The time required to dry sheets containing 50 per cent. of water is about five hours, depending on the temperature of the air and the degree of dryness required.

The chamber process is practically the same; the only difference lies in the fact that the chain carrying the racks moves horizontally instead of vertically. The only reason (which, indeed, is an important one) why these processes are not used on this continent is the great cost involved in their installation and operation. Not only is a large building of special construction required, but during the process every individual sheet of pulp must be handled several times. Generally, when the pulp is not very well wrapped there is not much advantage in drying it over about 90 per cent., because it will absorb enough water from the atmosphere to reach that percentage when exposed.

Hughes Process.

The Riviere du Loup Pulp Co., of Fraserville, Que., have substituted in their recently-built pulp mill a new process (called the Hughes Process) for preparing the pulp for shipment. In this process the pulp is ground and screened as in the ordinary way, but from the screen the pulp passes over a simple form of "slush machine," which extracts the greater part of the water, leaving the pulp of about the consistency of porridge. In this form it is pumped directly into the Hughes hydraulic pump machine, which consists of a compression chamber, divided into four spaces by drainer plates covered with wire cloth to which compression chamber a hydraulic cylinder is attached, on which any desired pressure can be exerted. The pulp is admitted to this compression chamber and the pressure is applied which extracts the water through the drainer plates, and the finished product is delivered in the form of sheets 20 in. by 20 in. by 3/4 in. thick. The ordinary wet machine and hydraulic press are replaced by the Hughes press, with the result that a thick sheet of pulp, porous and spongy, is produced as compared with a matted or interlaced thin sheet obtained by the ordinary process. The percentage of water in both sheets should be approximately the same if the

*The above paper won the first prize given by the publishers of the Canadian Engineer for the best student's paper presented to the Canadian Society of Civil Engineers for 1903, the judges being members of the Society.

same pressure has been applied, but the former is appreciably more readily reduced to a liquid mass again in the beating machines of a paper mill. The new press, requiring as it does little more power than an ordinary hydraulic press, has this in its favor, that it dispenses with wet machines together with the power necessary to operate them, while the amount of floor space thus occupied is saved. If these presses prove as successful in their operation as is anticipated, their invention will mark a distinct advance in the pulp industry.

Uses of Mechanical Wood Pulp.

The chief use of mechanical wood pulp is, of course, to provide a paper-making material. It has many other uses, which yearly increase in number and importance, but at present it may be said to be all practically employed in the making of paper and cardboard. We have now examined these essential properties of pulp, the different sources from which it is derived, and the different processes by which it is obtained from wood; we have also seen the difference between a chemical and a mechanical pulp, and why this latter is naturally inferior in quality. This is why mechanical pulp alone does not produce a paper of good consistency; it is for this reason that it goes only as a percentage in the manufacture of paper. Some years ago it was thought that 50 per cent. of mechanical pulp was as much as could be allowed in the cheapest kind of paper, but on account of more improved methods of manufacturing both the paper and pulp as much as 85 per cent., and even 90 per cent. of it is used in some of the "news" paper. This is the recognized maximum, while the percentage below that may be anything down to zero, according to the quality of the paper produced. It is also largely used for cardboard and wrapping paper, where its percentage is again greatly varied. Outside of paper and cardboard, wood pulp is now employed in the manufacture of a great number of articles of common use, such as pails, tubs, trunks, cases, barrels, etc. Complete houses, and even car wheels have been made of it.

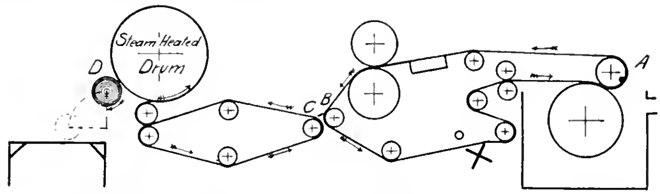


Fig. 38. Sectional Elevation of Dry Pulp Machine. From A to B is same as ordinary Wet Machine. From C to D is the Drying Part.

Manufacture of Paper.

To carry out our system of treating this subject, it is necessary to give a short description of the manufacture of paper. When the pulp is brought in bales to the paper mill it is first introduced, together with a proper percentage of other kinds of pulp, with water into a beating machine, where all the particles are separated from each other; from there it is sent to a tank or to a mixer, where the desired amount of loading or sizing material, such as kaolin or talc, is added, and the whole is bleached or colored, as the case may be; this is then diluted with a large amount of water so as to form a very fluid substance. In this state is it admitted to a Fourdrinier machine, where the water containing pulp is allowed to a certain depth on a travelling wire sheet, which retains the pulp and allows the water to pass through. This wire sheet then passes over suction boxes and delivers the pulp to three successive felts, on which it is pressed. From the last felt the sheet, now of a certain consistency, passes around a series of drying drums and cylinders, through a calender which gives the paper a required glaze, and finally the sheet is rolled or cut ready for use.

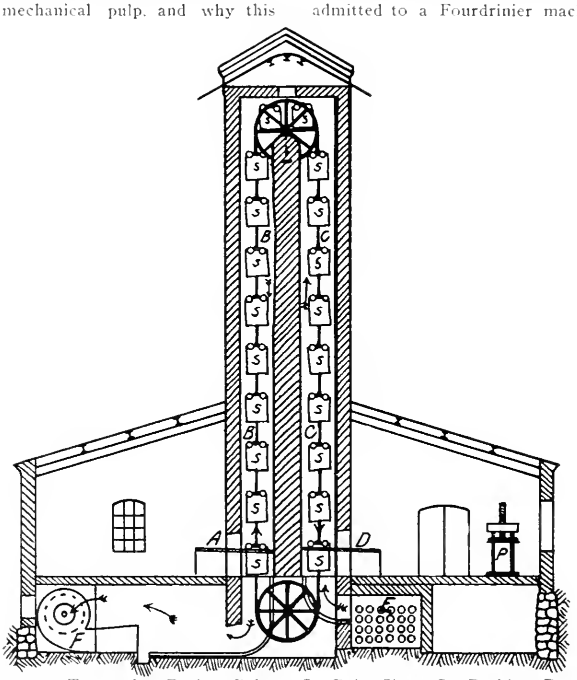


Fig. 39—Tower for Drying Pulp. S.—Pulp Sheets. P—Packing Press.

Cost and Value of Mechanical Pulp.

The cost of producing a ton of mechanical wood pulp in Canada, assuming the cost of wood to be about $4 per cord, is from $8 to $9, under ordinary circumstances. The great difficulty and what influences the most its value at the mill is its transportation to markets, in our cases, Great Britain and the United States principally. The price paid in Great Britain is sometimes as low as $12 to $15, and as high as $25 to $30 per ton, depending on general rules of supply and demand. In the United States, last year, the price varied from $13 to $25 per ton, dry, delivered. Their import duty is about $1.92 per ton. It is generally considered that mechanical wood pulp at $17 a ton in the United States or Great Britain, could be manufactured with profit in most parts of Eastern Canada.

Statistics and Remarks.

The statistical Year Book of Canada shows that during the calendar year, 1902, the wood pulp industry was carried on by 35 mills, 4 of which manufactured soda pulp, 9 sulphite pulp, and 25 mechanical, and 4 make both chemical and mechanical. These mills had an output of 240,989 tons; of this quantity 155,210 tons were mechanical pulp, 76,735 tons sulphite, and 9,044 tons soda; having a total value of $4,383,192. In 1881 the census returns show that there were in Canada five pulp mills, with a total output valued at $63,000. This shows that the growth of this industry in the last twenty years has been considerable. The Customs returns for the calendar year, 1902, show that during that year the export of pulp amounted to $2,511,666, leaving $1,871,518, or 43 per cent. for home use. Of this export, Great Britain took $976,172; United States, $1,518,319, and other countries $17,333.

Our export to Great Britain was about 8½ per cent. of her needs, and therefore all our mills could not supply their demand. Owing to the duty on pulp imported into the United States and the facilities afforded them in securing wood for manufacturing pulp in their own mills, the Americans are stripping our forests in the Provinces of Quebec, New Brunswick and Nova Scotia. About one-half of the pulpwood used in the United States is derived from Canada, as their home supply is becoming scarce, and at the present rate of consumption would be exhausted within a century if they could not import wood from here. It is a well-known fact that we have the largest pulpwood forests

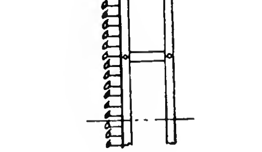


Fig. 40—Sheet Wagon or Frame.

in the world, and this added to our large amount of available water-power, makes a perfect combination as a source of wealth. According to J. C. Langelier, of Quebec, we could supply the world with 1,500,000 tons of pulp annually for 840 years with our present forests. Hitherto this wealth has been little taken care of as little legislation has been passed to prevent its waste and regulate forest operations; but the Canadian people are becoming alive to the advantages of reforestration and to the necessity of preserving their forests by strict regulations regarding the cutting of the wood. It is to be hoped that in the near future the science of forestry will be applied here with the same efficacy it has shown in some of the European countries.

We have seen that great pains are taken to dry pulp for shipment, and also that if paper and cardboard were made directly here, we could dispense with wet machines

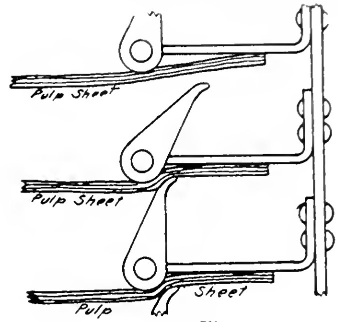


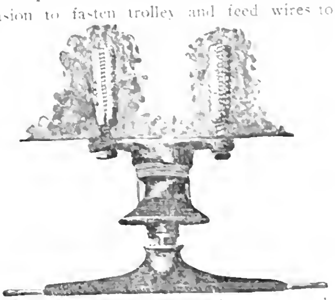
Fig. 41—Clips.

and presses. Both capital and labor will be saved by making paper and cardboard directly at our pulp mills; then Canada will surely become the greatest paper producing country in the world.

For a large amount of information contained in this paper the writer is indebted to the following: A paper on the Process of Manufacturing Mechanical Wood Pulp, read before the Engineering Society of the School of Practical Science, Toronto, in 1898-99, by W. A. Hare, "99," to catalogues and descriptions from the following firms: Jenckes Machine Co., Sherbrooke, Que.; the Waterous Engine Works Co., Brantford, Ont., and Carrier, Laine & Co., Levis, Que., and to different articles published in the Canadian Lumberman, and in the Pulp and Paper Magazine, both of Toronto.

DIAMOND EXPANSION SHIELD.

The Diamond Expansion Shield, shown herewith, will be of interest to telephone and telegraph companies, electric light and power companies, miners, railroad companies, and others having occasion to fasten trolley and feed wires to brick or



stone buildings, the roof or walls of mines or tunnels, and also for attaching electric wires to brick, stone, concrete, or other masonry. If desired, a pin with standard insulator threads can be cast on the bolt making it unnecessary to use wooden pins, or the bolt can be made for inserting into the wooden pin. The

Diamond Expansion Shield can be used to advantage in place of wooden plugs, sulpher, lead, wedge bolts, etc., which seldom give good results. The shields are made of metal, threaded on

the inside to receive the screw, thicker at the outer end to expand as the screw is run in, and a roughened outer surface to grip the sides of the hole. When properly set, they will not work loose and cannot be pulled out except by actually working the material from around them, but at the same time may be removed by simply unscrewing the belt. The operation of the shield is very simple; a hole is drilled, the shield inserted, and the screw run in. The shield insures a positive hold in any solid material and the greater the strain on the belt the more the shields grip the sides of the hole.

The shields are made in sizes from ⅛-in. to 2-in. diameter screw, and are manufactured by the New Jersey Foundry and Machine Co., of 9 Murray St., New York.

POLYPHASE EQUIPMENTS OF SOME EUROPEAN HIGH SPEED ELECTRIC RAILWAYS.*

The operation of railway systems by electric power is a subject of special interest to countries like Canada, possessing such remarkable natural resources in the way of water power.

The application of alternating current induction motors to electric railroading has not made much headway in this country and in the United States, continuous current motors having almost absolute sway. In Europe, however, much work has been done, and at the suggestion of our president, I will endeavor to point out very briefly the characteristics of two high tension three-phase R.R. systems, viz.: The Valtellina R.R., in the north of Italy and the Berlin-Zossen Road in Germany.

The Valtellina three-phase 3,000 volt R.R. system has been equipped by Ganz & Co. of Budapest. The length of this road is slightly over 66 miles and the maximum grade 2 per cent. The power is derived from a waterfall on the Adda river, near the town Morbegno. The station consists of three 1,500-K.W., three-phase, 20,000 volt., 15 cycles generators, direct connected to three 2,000-h.p. Francis turbines working under 100 foot head. Three-phase current is sent on an overhead line to twelve sub-stations, where it is transformed to 3,000 volts and supplies twelve independent sections of the R.R. system. These sub-stations each contain one three core, three-phase air blast transformer, of 300-K.W. normal rating, but capable of working

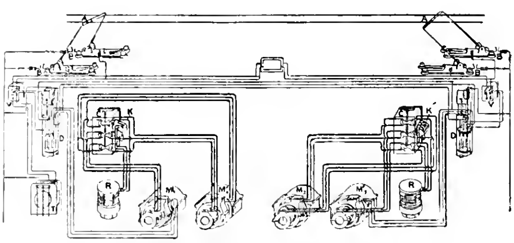


Fig. 1.

for short periods up to 900-K.W. The cooling apparatus, a fan, is driven by a small induction motor. The sub-stations are about six and one-quarter miles apart. Passenger and freight traffic are operated independently, passenger traffic by motor driven cars, freight trains by electric locomotives. The passenger cars weigh 53 tons and are capable of hauling, beside their own weights, five trailers of ten tons each on a 2 per cent. grade at a speed of 40 miles an hour. These cars are mounted on two four-wheel trucks. Two motors of 150-h.p. each are provided for each truck, giving four motors per car. These motors are gearless, the rotor axle is hollow and permits the car axle to pass through it. The rotor shaft or sleeves is connected to the car axle by a flexible coupling, a modified form of a drag link. Jar and vibration are thus prevented. Control of the motors is made from both ends of the car a controller being provided to each platform, to which the passengers have no access. These controllers are mechanically inter-connected and have only three positions. Each motor car is fitted with two primary and two secondary motors. The primary motors have six poles and are rated to develop 150 B.H.P. at 300 revolutions per minute under 3,000 volts, 15 cycles. The diameter of the car wheels being 3.84 feet, the maximum speed of the car is close to forty miles an hour. The maximum torque these motors can develop is from four to five times their normal torque. There is practically no difference in weight and design between the primary and secondary motors, which are also rated at 150-h.p. under 300 volts and 15 cycles.

Fig. 1 gives a diagram of connections of one of these cars. In starting the two motors M_1 and M'_1 on a truck, are connected in concatenation or cascade. The stator winding of motors M_1 and M_2, the primary motors, are connected to the 3,000 volt line A through the high tension switch D. The rotor of these motors (ratio 10 to 1), thus giving 300 volts, are connected through the controller C to the stator windings of the secondary motors M'_1 M'_2. The rotor of these motors (ratio 1 to 1), are each connected to a three-phase liquid rheostat R, containing an alkaline solution, the resistance of this rheostat depending on the quantity of liquid which is forced and regulated into it by compressed air. When the liquid has reached a certain height an automatic arrangement short circuits the rotor windings. With the motors in concatenation the speed is approximately twenty miles an hour. It is well to mention here that before a start is made the controller is placed in position with the motors in concatenation before the primary switch D is made, throwing the 3,000 volt on the primary motors stator windings.

To obtain full speed, that is forty miles an hour, the primary switch D is opened, the controller is placed on third notch, cutting the low tension motors out of circuit and connecting the liquid rheostat to the rotor of the primary motors, the high tension switch is then closed, the primary motors are then alone in circuit. This method of control is very similar to the ordinary series-parallel control.

The 300 volt reversing switch consists of six copper plungers, which, when lowered, fit into an equal number of copper cylinders; by rotating the switch through sixty degrees the connections of the phases are changed, thus reversing the direction of rotation of the motors. This switch is operated from the end platforms by compressed air or if this fails, by hand.

The controller has only three points.

First point: Rotor of primary motors open circuited.

Second point: Concatenation control.

Third point: Secondary motors out of circuit and the liquid rheostat connected to the rotor of the primary motors.

This controller is operated by hand as the voltage on it does not exceed 300 volts. Freight trains are hauled by electric locomotives. These locomotives weigh about forty tons, and are capable of hauling a 250-ton train on a 2 per cent. grade at a speed of 20 miles an hour. The body of these locomotives is mounted upon two four-wheel trucks and upon each of the four axles a motor is directly mounted, no gearing being used. Concatenation control is not used in these, the four motors are high tension motors and rheostatic control in the rotor circuit is employed.

Great difficulty was at first experienced in working an overhead trolley circuit with two wires under 3,000 volt pressure between wires, the third-phase wire being the track. The trolley wire in size is equivalent to our No. O. B. & S.; these wires are placed 2 ft. 9 in. apart. According to circumstances, they are supported by brackets or span wire, flexible suspension being employed throughout. The insulators are of a special type, with long insulating bolts, and the wires are held by very short mechanical clips which pivot from the insulating bolt. The method of supporting the high tension feeders and the trolley wires, the type of insulators used, and the trolley insulators are shown in Figs. 2, 3 and 4.

The 3,000 volt current is taken from the trolley lines by a sort of bow trolley made up of two copper rollers 16 inches long and 3¼ inches diameter. These rollers which are mounted in the same axial line revolve upon steel ball bearings, and are separated by 5 inches of hard wood saturated in parafine under pressure. The current is transmitted by the rollers to highly

*Condensed from a paper by L. A. Herdt, assistant professor of McGill University, read before the Canadian Society of Civil Engineers.

insulated wires through carbon brushes held against the copper rollers. The current in this way is not allowed to pass through the steel bearings. The trolley wires are held 18 feet above the track. An arrangement inside the cab permits the lowering, by compressed air, of the trolley arms to disconnect the car from the overhead circuit. The high tension wires on the cars are all protected by grounded metallic tubing. I am indebted to L'Industrie Electrique" for much of the above data and for the following: To start a motor car with five trailers, a total weight of ninety tons, seventy to ninety amperes are required; at 3,000 volts this is equivalent to 415 K.V.A. Power factor of primary and secondary motors at max., torque when concatenated, 70 per cent. When running full speed, the secondary motors being out of circuit, the current varies between fifty-two and fifty-six amperes. The power factor, 80 per cent. To start a train weighing 250 tons on a 1.1 per cent. grade, 150 amperes are required, viz.: 810 K.V.A. The maximum horizontal pull is 16,000 lbs. On 4.4 feet diameter driving wheels and twenty miles an hour the horse-power developed is close to 875-h.p. There are at present ten motor cars and two locomotives in daily service, consuming an average of 9,000-K.W. hour per day. The station equipment for this work is equal to 6,000-h.p showing a rather small load factor.

The trials of high speed traction taking place at the present day in Germany over the Berlin-Zossen road, where speeds of 130 miles per hour have been obtained, have attracted the interest of railroad engineers all over the world. These trials and experiments have now extended over a period of two years. The first trials at high speeds were made with an electric locomotive, as it was deemed advisable to perform experiments with it rather than with a motor car. The line voltage is 10,000, three-phase, 45-50 periods per second. The underframe of the locomotive is of the double truck construction of a pair of motors, being provided for each bogey. The motors are designed to work at 10,000 volts. The wheels have a diameter of 4 ft. 4 in., and the motors are geared to the axles of the driving wheel with a gear ratio of 2. The speed at starting is regulated by varying a resistance in the rotor or secondary circuit. Speeds of ninety miles an hour were obtained with this locomotive. It was found, however, that it was not sufficient at these high speeds on account of the velocity of the teeth being exceptionally great to fill the gear box with oil or consistent grease, but that lubricants had to be forced by compressed air through nozzles directed above and below the toothed wheels.

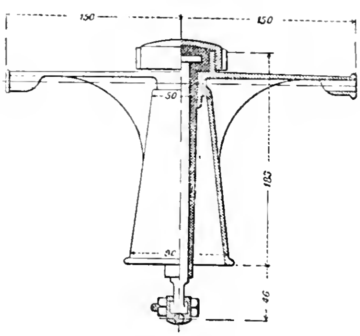


Fig. 2.

The more recent tests have been made with a motor car, 3,000-h.p. maximum. The starting and regulating apparatus for an output of 3,000-h.p. could not be built on the lines of the ordinary car controllers, and many costly experiments were necessary to test new types of apparatus designed for this purpose. The motors are not geared, the rotor axle is hollow and permits the car axle to pass through it. The transmission from rotor axle to driving wheels is shown in Fig. 5. A ring in three parts is placed at each end of the hollow shaft, in which are fitted three double arms in the shape of sets of springs, the ends of which bear against sliding pieces fixed on the wheels. The sliding and elastic movement [illegible] the regular working and play of [illegible] I understand that a slight modification [illegible] has been made. The electrical equipment [illegible] into two units, the control of these [illegible] made from either end of the car [illegible] travel. Each contains: (a) Two [illegible] ances and two starting devices [illegible] transformer with high and low [illegible] pumps with small transformers [illegible] which rests on two six wheel bogey trucks, [illegible] two to each truck, one attached to the front and rear [illegible] each truck, the middle pair of wheels [illegible] free. The four motors have a total of 1,100 [illegible] (d) One current collector. (e) A driver's [illegible] sure mechanism for working the apparat[illegible] cables and safety appliances are placed in a room [illegible]

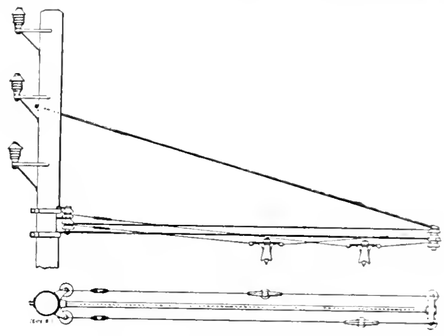


Fig. 3.

of the car. The motorman's platform contains no part under electric pressure, he controls the running of the car through mechanical connections with the apparatus in the central machine room. Some place had to be found for the transformers weighing twelve tons, reducing the 10,000 volts of the line at which voltage the current is supplied from the three overhead

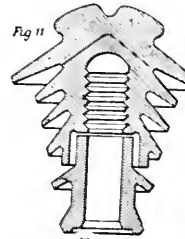


Fig. 4.

lines to 1,150 volts, the primary tension for which the motors are built. These are placed underneath the car body in the middle section. The cooling of these transformers is made through air currents passing through two air shafts, which run from the roof of the car to the transformers in such a manner that cool air is taken through one shaft, the hot air flowing out through the other. Concatenation control is not used, and to bring the motors up to the speed, starting resistances are inserted in the secondary current circuit in the usual way. On account of the space under the flooring of the car being already taken up by the transformers and connections, and to obtain as large a cooling surface as possible and as high a degree of efficiency for the weight as possible, the metallic resistances are carried against the sides of the car. A battery of 031 lbs. furnishes the current for lighting when the car is standing with the trolley off the lines. It is out of the scope of this paper to describe in detail the working of this equipment, it does not however, materially differ from the description of the previous one cited. Each car is seventy-two feet long, and weighs ninety tons. The track on which these high speeds have been obtained is a nearly level line throughout its length of eighteen miles and the track is in every particular up to the highest standard

of railway construction. "The Electrical World and Engineer," states that when going at the rate of 130 miles an hour the steadiness of the car did not make the impression of so great a speed being obtained, but that persons or objects standing near the track presented blurred images as the car dashed

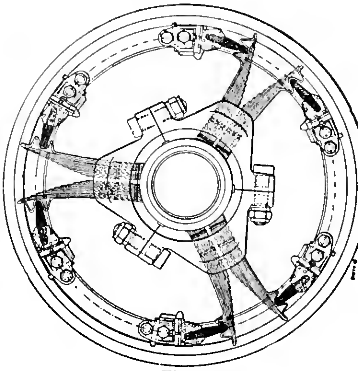


Fig. 5.

past. So far as the reports go, they point to the satisfactory operation of the whole electrical equipment. The main results of these experiments will be to show under what conditions high speed electric railroading is practicable and what it will cost. German engineers must be highly complimented on the work already done and on the enterprise they have shown.

BOILER SCALE AND THE SUNNYSIDE CASE.

Editor, Canadian Engineer:

SIR,—There is one point of interest common to all boilers, viz., the extent and composition of the scale, and in this connection curiosity led me to take a sample of the scale of the boiler that burst at "Sunnyside," Toronto, on September 14th, resulting in two fatalities and five men injured. Being much interested in the question of boiler feed and boiler scale, I made an analysis of the sample, which (together with others, I add for comparison), may be of general use to those taking water from the same source:

All samples dried at 212 deg. F.

	No. 1. Sunnyside. Fed from Humber Bay.	No. 2. From Toronto Water.	No. 3. From Toronto Water Compound Used.	No. 4. Artesian Well Feed.
Oil	.40	....	....	9.03
Organic matter and water of combination	7.79	10.58	3.62	.44
Carbonate of lime	57.55	52 02	72.86	74.06
Sulphate of lime	4.87	9.29	.51	.20
Carbonate of magnesia	4.87	1.22	8.97	6.61
Magnesia	19 72	13.81	7.03	3.04
Oxide of iron and Alumina	2 94	3.12	3.42	1.65
Salt	2.94	3.12	.07	Trace
Silica	5.59	9.96	3.52	3.71
Undetermined	1.14	9.96	3.52	3.71
	100.00	100.00	100.00	100.00

No. 1, the Sunnyside boiler was fed from Humber Bay; Nos. 2 and 3 were boilers fed from Toronto city water; on No. 3 was used a so-called boiler purge; No. 4 is scale from a boiler fed from an artisian well; on this scale also was used a commercial "purge."

In order to make comparisons, I give my analysis of Toronto water, expressed, as is customary, in grains per gallon, and also as per cent. (The grain and gallon do not lend themselves as easily to per centage calculation as the Metric Weights and Measures). Toronto water contains 9.2 grams per gallon of solid residue, composed as follows:

	Gr. per Gal.	%
Organic matter and water of combination	1.40 =	14.97
Carbonate of lime	5.38 =	57.54
Oxide of iron and alumina	.06 =	.64
Sulphate of magnesia	1.41 =	15.19
Sodium chloride (salt)	.82 =	8.77
Silica	.28 =	2.99
	9.35	100.10
Error in excess	.15	.10
Total	9.20	100.00

In scale analysis Nos. 1 and 2, we have a deposition fairly comparable with the Toronto water from which they were deposited.

In No. 3 we have a scale deposited also from Toronto water, but which has been acted upon by one of the so-called "boiler compounds" of commerce, with the result that the per cent. of everything has been lowered except the carbonates of lime and magnesia, the very materials which it is most desirable to be rid of. This case is typical of a great number more, where the ignorant practice of doctoring before "diagnosing" is applied to the boiler and scale. The proper way is to analyze both scale and water, and after a full knowledge of their composition has been obtained, act upon the calculations of only experienced people in this particular line. After a special purge has been used, the scale should again be tested and also some of the water in the boiler to get a full grasp of the chemical actions taking place.

In analysis No. 4, we have a singular case where the proprietors sank an artesian well to secure better water. They also used a "purge?" resulting in a scale showing nearly 75 per cent. carbonate of lime, and 6.61 per cent. carbonate of magnesia. Another very serious feature presents itself, viz., over 9 per cent. of oil; under no circumstances should this be tolerated, as the most cogent arguments can be urged against such conditions even should the oil be absolutely pure mineral oil. I would say, in conclusion, that I do not desire to draw any inference relating the sad mishap at Sunnyside with the scale, as the amount of scale in the boiler and the composition of that scale are decidedly above the average practice. The experts have passed their opinion, and the above analysis and remarks are offered only as of general interest and use.

HARRY SPURRIER.

Davenport, Toronto, 23rd Sept.

ELEVATOR EXPERT.

Editor, Canadian Engineer:—

Sir,—Will any of the readers of your paper be kind enough to supply me with the names of two or more of the most eminent of the mechanical experts in passenger elevators, either hydraulic, electrical or any other kind?

Carleton West, Ont. ENQUIRER.

—One of the features of the B. F. Sturtevant Co.'s new office building, at Hyde Park, Mass., is the lunch room located in the basement of the building. Arrangements were first made with a caterer to furnish lunches, but the desire for home lunches became so prevalent that the company now hires the help and furnishes lunches at cost. The new drafting rooms of the B. F. Sturtevant Co., at Hyde Park, Mass., contain about 5,000 sq. feet of floor area. The chief draftman's office is in the centre of the room with two large vaults nearby in which are kept all the tracings, numbering in all about 30,000. The room is 13½ ft. high, well lighted and equipped with all conveniences for draftsmen. The Blue-Print Department is connected to the drafting room by shop telephone and dumb waiter.

DOUGLAS FIR. (Pseudotsuga Douglasii)

Ultimate Breaking Stresses in lbs. per Square Inch from Experiments by Various Authors.
Compiled for the Canadian Engineer by E. Mohun, C.E.

AUTHOR.	REMARKS.	TENSION WITHGRAIN	CRUSHING ENDWISE.	CRUSHING SIDEWISE.	EXTREME SKIN STRESS. LIMITS.	EXTREME SKIN STRESS. MEAN	MODULUS OF ELASTICITY. LIMITS.	MODULUS OF ELASTICITY. MEAN.	SHEARING WITH GRAIN LIMITS	SHEARING WITH GRAIN MEAN	WEIGHT PER CUBIC FOOT.	BREAKING LOAD OF BEAM 1 IN SQUARE 1 FT SPAN LOADED AT CENTRE LIMITS	BREAKING LOAD OF BEAM MEAN
(a) Prof Bovey	Specially selected	14,311			8,020 to 10,444	9,054	1,934,500 to 2,178,100	2,056,523	397 to 440	411	41.	445 to 580	503
	New Timber; First Quality	11,160	5,874		4,027 „ 8,382	6,084	926,500 „ 1,138,900	1,431,203	290 „ 456	396	35	224 „ 466	338
	Old Timber, Old Can. Pac R^y Stringers	12,663	6,265		4,613 „ 7,339	6,293	543,720 „ 1,201,620	1,423,962	302 „ 371	328	35	256 „ 408	350
	Included in preceding												
	44 Pieces New Timber, straight grained and clear		7,098										
	20 „ Old „ „ „ „ „		7,070										
(b) Oregon & Cal.^n R^y		16,600	3,085	1000		8,658							481
(b) J.D Isaacs.	Southern Pac R^y	15,800	6,000					1,272,000		600			
(b) Report of Am	Chapter Am Ins Architects					5,979							332
(b) Chas Wing.	Ordinary N° 1 Timber 10 Beams				5,580 to 7,951	6,482						310 to 442	360
	10 Small Beams				6,438 „ 12,056	9,257						358 „ 670	514
(b) Onward Bates	10 Beams				5,268 to 7,544	6,214						293 to 419	345
(b) A L Johnson.			4,400	500		6 600		1,380 000					367
(c) E. Mohun	Specially selected, straight grained free from knots and flaws, partly seasoned. All test pieces 1 inch square		7,000	1,750	10,800 to 11,700	11,484		1,585,000			34	600 to 650	638
(d) Prof Frank Soule	63 Pieces	14,388											
	53 „		5556										
	Indentation 3 per cent 113 „			879									
	15 83 „			1,215									
	21 „					3334		1863,947			3699		510
	85 „									546			
E A Wilmot	Old bridge stringer, damaged, 10"x12 x 37 6"					8,290							461
	MEAN	14170	5824	1,083		7,811		1,570,285		456	36 50		434

RECOMMENDED VALUES

AUTHOR		TENSION	CRUSHING ENDWISE	CRUSHING SIDEWISE	SKIN STRESS	MODULUS OF ELASTICITY	SHEARING WITH GRAIN	WEIGHT PER CUB FT	BREAKING LOAD OF BEAM
(a) Prof Bovey	Ultimate Stress		6,000		6 000	1,430 000	400		333
	Factor of Safety				3				3
	Safe Working Stress				2 000			34	111
(e) Am Association of Superintendents of Bridges, &c	Ultimate Stress	10,000			5,000				278
	Factor of Safety	10	5	4	6	2	4		6
	Safe Working Stress	1,000			833				46
(b) A L Johnson	Ultimate Stress		4400	500	6 600	1,380,000			367
	Factor of Safety	1	5	3		2	4		5
	Safe Working Stress		880	167		690 000			73
(c) E Mohun	Ultimate Stress	14000	5,000	1200	6,000	1,400,000	400		333
	Factor of Safety	10	5	4	3	2	4		3
	Safe Working Stress	1400	1,000 (f)	300	2,000	700,000	100	37	111
(b) J Brown S Pac R^y	Ultimate Stress	15,900	6,000		13,430	1,376,000	600		702

(a) Prof Bovey Trans Can Soc C E Vol [illegible] 1895
(b) A L Johnson C.E. Bulletin to Div^n of Forestry, Dep^t of Agr^re U.S.A.
(c) E Mohun C E Indian and Colonial Exhibition, 1886, Trans Can Soc C E Vol II 1888
(d) Prof Frank Soule Trans Am Inst M E 1900
(e) Committee Report Am Ass^n of Railway Superintendents of Bridges and Buildings, 1895
(f) When the length does not exceed fifteen times the least diameter
(g) Deduced from C S Smith's formula
(h) Deduced from Tredgold's formula

BEAMS SUPPORTED AT BOTH ENDS

FORMULÆ

Let L = clear span in feet; l = clear span in inches; b = breadth of beam in inches; h = height of beam in inches; W = total load in lbs; θ = length of end bearings

UNIFORMLY LOADED

S = safe load in lbs; F = skin stress; E = modulus of elasticity; Δ = deflection in inches

$$S = \frac{222\,b\,h^2}{L}$$

$$F = \frac{3Wl}{4bh^2}$$

$$E = \frac{5Wl^3}{32\Delta bh^3}$$

$$\Delta = \frac{5Wl^3}{32Ebh^3}$$

$$\delta = \frac{Wl}{220h^2}$$

LOADED AT CENTRE

s = safe load in lbs; f = skin stress; e = modulus of elasticity; δ = deflection in inches

$$s = \frac{111\,b\,h^2}{L}$$

$$f = \frac{3Wl}{2bh^2}$$

$$e = \frac{Wl^3}{4\delta bh^3}$$

$$\delta = \frac{Wl^3}{4ebh^3}$$

$$\delta = \frac{Wl}{111h^2}$$

$$\theta = \frac{W}{333b}$$

(k) When the deflection = [illegible] of the span, and [illegible]
[illegible]

REMARKS

The foregoing safe working stresses are estimated for first quality timber, such as would be accepted by a competent inspector for bridge or trestle work.
The life of such a structure under the variable climatic conditions may be estimated at about twelve years.
Beams covering more than one span or securely fixed at both ends are stronger than beams merely supported at the ends by [illegible] per cent.

(g) PILLARS
[illegible]

(h) INCLINED BEAMS
[illegible]

THE NORTH BAY ACETYLENE PLANT.

Editor, Canadian Engineer:—

SIR,—Your interesting article on town lighting by acetylene in the September issue of the "Canadian Engineer," will no doubt do much to bring the new gas light to the attention of practical people throughout Canada. In your reference to the earnings of the acetylene plant in North Bay, there is a slight error as to the amount of profit. While the income of the plant for this year ending 30th June, 1905, will be in excess of $4,000, and the earnings of the electric plant will be in the neighborhood of $10,000, it would be wrong to claim that the profits from the $4,000 would be as great as the profits on the $10,000. What we do claim for acetylene is that the ratio of profit for the town plant of say 2,000 lights should be greater than the ratio of profit from an electric plant with 2,000 lights, especially when steam is used to generate the electricity.

It may interest you to know that the Gas Company have bought out the Electric Company in the town of North Bay, and a new charter has been applied for for the amalgamated companies. The name of the new company is: "The North Bay Light, Heat and Power Co." This is the first instance on record where an acetylene town lighting plant and an electric town lighting plant have been combined.

Yours truly,
A. F. LEGGATT,
President, North Bay Gas Co.

ELECTRICITY FROM WATER POWER.*

By A. A. Campbell Swinton, M.I.C.E., M.I.E.E.

It should be gratifying to our national pride to know that probably the very earliest example of the production of electricity by means of water-power on a practical scale, and its transmission to a distance, was the installation put up, for the purpose of lighting, at Cragside, Northumberland, by the late Lord Armstrong, in the year 1882. This plant, which was still in daily use in the year 1884 when the author saw it in operation, consisted of a Siemens continuous-current dynamo, which was driven by means of a belt off an 8-h.p. water turbine operating with a fall of 30 feet, the electricity, which was delivered at ninety volts pressure, being carried by bare overhead wires attached to porcelain insulators on poles to the house about a mile distant. It is an interesting fact that when the installation was first put to work it was designed to operate with only a single wire, connection being made to the hydraulic power pipes at the one end and to the ordinary household water pipes at the other, the earth being expected to form a sufficient return in the manner employed in telegraphy. This plan, which was adopted on the advice of the late Sir William Siemens, was found to be quite ineffective, as, owing to the low voltage employed and the exceedingly rocky nature of the ground no useful amount of electricity could be transmitted until the earth return was done away with and a second metallic conductor substituted.

Though this twenty-two-year-old English example of electricity developed by water-power and transmitted to a distance, was, as already mentioned, probably the first such installation in existence in the world, the great development of such installations has, up to recently, taken place almost exclusively abroad. No doubt up and down this country, a very considerable number of small electric plants operated by water-power, have been put up for private house lighting and such like purposes, and there are even towns such as, for instance, Salisbury and Keswick, where water-power has for long been employed to assist steam power for electrical production for public and private lighting, the water-power being in these instances found of great value for the purpose, more especially of maintaining the supply during the periods of minimum load. A few hundred horse-power will, however, probably cover the whole of the plants of this character at present running in Great Britain, which is an altogether insignificant amount compared with the much larger corresponding figures for the continent of Europe, America and other countries.

To obtain accurate statistics as to the amount of water horse-power at present employed for electrical production throughout the whole world is a very difficult matter, as in many countries no figures are available, while in others, such as are obtainable are not up-to-date.

The following table, giving an aggregate horse-power of nearly 1½ million comprises all the hydraulic electricity works of which the author has been able to obtain particulars. He has, however, no doubt that there must be many others in existence to which he has not been able to find any reference, while again, in the case of a number of the installations which have been included, the horse-power now employed is greater than that in use at the time that the statistics were made out.

Water-power Electricity Installations.

	Horse-power.
United States of America	527,467
Canada	228,225
Mexico	1,470
Venezuela	1,200
Brazil	800
Japan	3,450
Switzerland	133,302
France	161,343
Germany	81,077
Austria	16,000
Sweden	71,000
Russia	10,000
Italy	210,000
India	7,050
South Africa	2,100
Great Britain	11,906
Total horse-power	1,483,390

It therefore seems reasonable to suppose that the total amount of water-power actually used for electrical production throughout the world at the present time must exceed 2,000,000-h.-p., which is about double the total steam power at present devoted in Great Britain and Ireland to the same purpose.

It is interesting to calculate what would be the amount of coal required to produce this large amount of horse-power were it generated by steam engines in the ordinary way; in other words, what is the saving of coal that the adoption of this amount of hydraulic power entails. Many of the hydraulic plants, particularly those which are used for chemical processes, operate at full power continuously night and day, but others work for shorter hours. Assuming, however, that the whole 2,000,000-h.-p. is in use for 12 hours per diem, in other words, is employed on the average with what engineers call a 50-per-cent. load factor, and assuming, as is reasonable, that were the energy produced by means of coal, at least 3 lbs. of this fuel would be required on the average per horse-power hour, we get 5.86 tons of coal per horse-power year, or 11,720,000 tons of coal saved annually on account of the 2,000,000 h.-p. utilized. Though this may appear a large figure, it amounts to less than 2 per cent. on the total output of coal in the world, which, on the average of the last five years, was 632,000,000 tons per annum. Assuming, however, an average cost of coal of 10s. per ton, this 11,720,000 tons represents £5,860,000 yearly, an amount which it would take over £100,000,000 of capital earning 5 per cent. per annum to provide.

Apart from mere magnitude, many of the more recent examples of hydro-electric engineering abroad, especially in America, are interesting, by reason of the enormous distances over which the electric energy is being economically transmitted, and the very high electric pressures that in numerous cases are being successfully employed.

The longest distance over which transmission has so far been commercially effected, is probably the 232 miles of line

*A paper read before the British Association.

belonging to the California Gas and Electric Corporation, which stretches from the De Sabla Power House via Cordelia to the Town of Sausalito, which is situated on the opposite side of the Golden Gate Straits from the city of San Francisco. What this transmission means will be realized when it is stated that the distance covered is about equal to that which separates Cambridge from Newcastle-on-Tyne. The same Californian company also owns the Colegate and Oakland transmission line which runs 142 miles from the Colegate power house, where 14,000-h.-p. is developed from a head of water of 702 feet.

Another very long line is that which reaches from the Electra power house, via Stockton and Mission San José to San Francisco, a distance of 147 miles, over which 10,000 h.-p. is being delivered regularly. This line belongs to the Standard Electric Company, who have 217 miles of power line with a capacity of 27,000-h.-p. in operation. The voltages employed, as is to be expected having regard to the distances covered, are very high, ranging from 55,000 to 67,000 volts, 60,000 volts being apparently the standard figure for many recent installations of which the following are some examples:—

Plants Recently Installed by the Stanley Electric Manufacturing Company, Pittsfield, Massachusetts.

Name.	H.-P. capacity.	Voltage.	Transmission distance, Miles.	Head of water Ft.
Quanajuato Power & Electric Company, Mexico	8,000	60,000	101	300
Washington Water Power Company, Spokane	12,000	60,000	110	08
Kern River Power Company, Los Angeles, California	16,000	67,500	110	...
Pierce Company	26,000	55,000	40	...
Mexican Light and Power Company, Mexico	......	60,000	110	1,500
Winnipeg General Power Company	10,000	60,000	60	40
Canadian Niagara Power Company	.....	60,000	93	...
Electric Development Company, of Ontario	......	60,000	93	...

For these particulars the author is indebted to Mr. C. C. Chesney, the chief engineer of the Stanley Electric Manufacturing Company, who have recently installed these and numerous other similar plants.

Mention should also be made of the 50,000-h.-p., and the 125,000-h.-p. plants for the Canadian Niagara Power Company and the Electric Development Company of Ontario, contracted for by the Canadian General Electric Company, both of which will employ pressure range up to 60,000 volts, while, to pass to another quarter of the globe, the Cauvery Falls electric-power scheme in India has now been at work for over two years, and transmits 5,000 h.-p. to the Mysore gold mines, a distance of 92 miles, using a pressure of 35,000 volts.

Turning now to the British Isles, the only large scale plant for the production of electricity by water-power at present in operation in this country is the well-known installation of the British Aluminium Company at Foyers. This installation, which was originally designed by the late Mr. Birch, and carried out by Mr Vaux Graham, has been at work ever since the year 1896, and the whole of the power is employed for electro-chemical purposes on the spot. A small percentage of the power is utilized for the production of calcium carbide, but the bulk is and in the near future the whole of the power will be used for making aluminium. At present, the gross horse-power of the plant is 7,000 h.-p., but plant for a further 2,000-h.-p is at the present moment being installed, and will be working in about a month's time.

The water is derived from the River Foyers, which has a catchment area of upwards of 100 square miles. Storage is effected by means of two lakes which have been joined together by the raising of dams and embankments, the result being a continuous lake of about $5\frac{1}{2}$ miles long by about $\frac{1}{2}$ mile in width. The storage thus obtained is sufficient to run the entire plant continuously day and night for about fifty days.

From the River Foyers, the water is first passed through a tunnel $8\frac{1}{2}$ feet in diameter, cut through the solid rock, to the penstock chamber from which the water is delivered by separate cast-iron pipes to the turbines, which are installed on the shore of Loch Ness, and into which the water is finally discharged, the available head of water being 350 feet.

The British Aluminium Company have obtained Parliamentary powers for a further large power installation on Loch Leven. It is their intention to commence immediately the development of this scheme, which is capable of giving 17,000-h.-p. The reservoir is artificial, and will contain about 150 days' storage of the full power, the head of water at the turbines being 964 feet. It is anticipated that the whole of this power will also be taken up in the manufacture of aluminium on the spot, no distant transmission being, at present at any rate, contemplated.

Another interesting water-power scheme of considerable dimensions is at the present moment being developed in Wales by the North Wales Electric Power Company, who have obtained Parliamentary powers for this purpose

Their first installation is at present being erected under the superintendence of Messrs. Harper Bros., the company's engineers, and derives its power from Lake Llydaw on Snowdon. This lake, into which runs the water from Lake Glaslyn, is about 1 1-5 mile in length, and about ¼ to ½ mile in width. Its area is 5,500,000 square feet, and it derives its water from a catchment area of about 1¾ square mile, including the summit of Snowdon. Being in the track of the Atlantic depressions, this area has one of the heaviest rain falls in Europe, amounting on the average to 180 ins per annum. In 1903 it reached the phenomenal figure of 250 ins.

The prevailing winds are from the sea, and the atmospheric moisture is driven up the sloping side of the mountain, and on being condensed at the summit is discharged in the form of rain or snow on the eastern side over Lakes Glaslyn and Llydaw.

The fall of the year gives the wettest months, and it happens that the quantity running from the lakes in spring is averaged by the snow melting on the sheltered eastern side.

By means of a dam about 100 feet in length, the level of the lake is to be raised 20 feet. The water will be drawn from the lake by means of a tunnel 600 feet in length at a point 30 feet below the present level, or 50 feet below the level when the dams are completed, with the result that there will be sufficient storage for meeting a 90-days' drought. The total fall utilized will be about 1,150 feet, and the total horse-power available—on the basis of nine-hours' working day—is calculated at 8,200.

The first installation consists of two steel pipe lines and four 1,000-kw. sets, each consisting of a double tangential water-wheel coupled to a three-phase alternator giving 11,000 volts at 40 periods per second.

The company will develop the full horse-power of Lake Llydaw before proceeding further, but they have also acquired a further water power at Llyn Eigiao in the Conway Valley, where a fall of 800 feet is obtainable, and where it is calculated there will be nearly twice as much horse-power available as there is at Llyn Llydaw

One of the first objects of the North Wales Electric Power Company, as soon as their installation is completed, will be to supply energy for the working of certain light railways which they control in the district. It is, however, in addition, intended to supply electric energy throughout a large area comprising the whole of the counties of Carnarvon, Merioneth, and Anglesea, and also a portion of the county of Denbigh.

Three-phase currents are to be used and the transmission lines will be of bare copper wires .324 inches in diameter, carried on insulators triangularly placed on wooden poles. A large proportion of the transmission lines will be carried along the track of the above-mentioned light railways. Lines are to be laid to the principal slate-quarry districts of Nantele, Llanberis, Penrhyn, and Festiniog, where a considerable demand for power exists. The distances from the power station to these places ranges from six to twelve miles.

The latest water-power electric scheme in the United Kingdom is that of the Scotch Water Power Syndicate, who have, by agreement, obtained from Lord Breadalbane and the Trustees of the Colquhoun Estate of Luss, important water-power concessions. These agreements have been negotiated by Mr. E. Ristori, who, it may be mentioned, was one of the original founders of the Falls of Foyers installation, while the engineering and electrical details have been worked out by Mr. William Vaux Graham and the author.

The first power that it is proposed to develop is one connected with Loch Sloy, which is situated some five miles north of Tarbet on the side of Ben Vorlich between Loch Long and Loch Lomond.

Loch Sloy, which is situated some 757 feet above Loch Lomond, which, in turn, is some 26 feet above the sea-level, is fed from a catchment area of about 3,801 acres, which includes one side of Ben Vorlich, which, with its 3,092 feet, is one of the highest mountains in Scotland. The district has the very heavy rainfall of some 74 ins. per annum, of which it is calculated that 60 ins. will be collectible.

A dam will be constructed at the eastern end of the loch, which will raise the height of the latter by some 60 feet. This will impound some 240,000,000 cubic feet of water, capable, with a calculated net fall of 700 feet to Loch Lomond, of maintaining some 6,000-e.h.p. on a 25-per cent. load factor for the maximum possible periods of drought which are calculated at 100 days.

From the loch the water will be taken in the first instance along an open conduit 3,650 yards in length which will follow the contour line round Ben Vorlich till a point is reached almost immediately above the position where the power-house will be constructed on the shore of Loch Lomond at a spot called Inveruglas. From the end of this conduit to the power-house the water will be conveyed in steel pipes, the length of the pipe-line being about 600 yards, and the height of the fall 700 feet.

From the power-house an overhead transmission line is to be constructed in duplicate for the purpose of conveying the electrical energy to the industrial areas of the Vale of Leven and the Clyde, which comprise the towns of Dumbarton, Helensburgh, Renton and Alexandria, and includes shipbuilding yards, engineering and dye works, calico printing works, and factories of various descriptions, many of whom have already intimated their desire to be supplied. The transmission line, for which private wayleaves have been obtained throughout, will be overhead on poles, starting from the generating station at Inveruglas and continuing across country for a distance of 22 miles to a sub-station which will be situated at Renton about mid-way between Dumbarton and the foot of Loch Lomond, in the centre of the Vale of Leven industrial area. At this sub-station the voltage will be reduced from 40,000 volts which it is proposed to employ for the long overhead transmission to some 6,000 to 10,000 volts, it being the intention that the distribution from the sub-station to the various works shall be underground.

The following are the efficiencies which it is calculated will be obtained:—

	Full Load Efficiency %
Open conduit, pipe lines, turbines	75
Three-phase generators	94
Step-up transformers	97
High-tension transmission line	93
Step-down transformers	96
Underground distribution (say 6,000 volts average)	95
Total efficiency	58.6

This is on the assumption of the energy being delivered to customers at 6,000 volts. If, as is probable in most instances, it will be delivered at lower voltages, there will be a further transformation, the efficiency of which will be 95 per cent. in the case of transformation in pressure only, and 80 per cent. in the transformation to continuous current, making a total overall efficiencies: 55.6 per cent. for three-phase current delivered, and 50.3 per cent. for continuous current delivered.

So soon as a market has been found for the total power procurable from Loch Sloy it is intended to utilize a further water power, for which the rights have also been obtained, at Ardlui, about two miles further up Loch Lomond. This power is also fed by a small loch with an available fall of 800 feet, the horse-power obtainable being about half that available at Loch Sloy. The Scotch Water Power Syndicate have, in addition, obtained the rights to still further water powers on the Breadalbane Estate that exist further north, and these will be utilized as soon as the demand for power justifies the capital expense.

It is because of these additional powers (which will considerably extend the length of the transmission) that it is proposed from the start to employ so high a pressure as 40,000 volts.

It is estimated that the total cost of the Loch Sloy scheme, including the transmission line and the distribution to the various factories, will not exceed £200,000 which, on a basis of 5,000-h.-p. delivered, works out at about £40 per horse-power, everything included. Seeing that many of the existing electric generating stations worked by steam have cost almost this amount for land, buildings, and generating plant, this does not appear to be an excessive figure, and it may be pointed out as an interesting fact that the 20 miles of overhead transmission line only accounts for some £24,000, or about 12 per cent. of the total expenditure. This, coupled with the fact that the calculated loss on the transmission line at full load will only amount to about 7 per cent., and the step-up and step-down losses to another 6 per cent., making 13 per cent. in all, all give some idea of the extent to which the length of the transmission line is but a comparatively unimportant factor in schemes of this description. It may be pointed out further that the above-mentioned line loss of 7 per cent. is upon the basis of only one of the two duplicate transmission lines being in use. When both are employed the line loss will be reduced to 3½ per cent., and the total transmission loss at full load will be only a little over 10 per cent.

The main transmission will be on the three-phase system over two sets of three copper conductors each, about 3-10 in. in diameter, the possibility of conveying as much as 5,000-h.-p. over a distance as great as 22 miles, with only 3½ per cent. loss by means of such comparatively small wires, being, of course, due to the high pressure employed. Indeed, using pressure as high as 40,000 volts, when it is a matter of transmitting comparatively small amounts of power, as for instance the 600-h.-p. or thereabouts, that under the present scheme it is expected will be required for the supply of the town of Halensburgh, the interesting point arises that the minimum size of conductor allowable is limited not by electrical conditions, but by considerations of mechanical strength.

On the main transmission line the conductors will be carried at a minimum height of 40 feet from the ground, while at all crossings over roads they will be enclosed in a wire cage to meet the Board of Trade requirements for insuring public safety.

The application of water power in the United Kingdom can, of course, never attain the dimensions that it has already reached in America and elsewhere, still, the above brief account of what is at present being done in Scotland and in Wales, shows that there are possibilities even in this old country, of which till recently but few were aware.

As regards the economies of electrical generation by water-power, no general rule can, of course, be enunciated, and every case must be dealt with on its merits according to local circumstances. This, notwithstanding it is possible to give an indication of what is generally involved, having regard more especially to the fact that with water-power as a rule interest on capital plays a much greater part in determining the cost than do labor or upkeep.

Avoiding on the one hand small powers where the costs are likely to be abnormally high, and on the other very large powers such as we do not possess in this country, it may be taken generally that interest on capital, depreciation, upkeep and working expenses in this country will amount to about 12 per cent. on the capital expenditure.

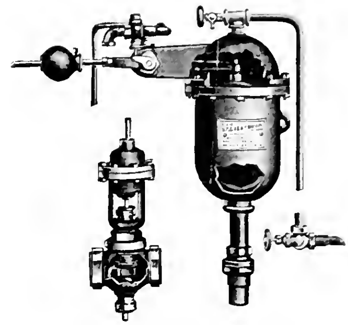
On this basis it is easy to see that to be economically sound, the capital involved must not exceed 8½ times the annual price which can be got for the whole of the energy. For instance, if 5,000-h.-p. is available for sale, and £6 can be got for each horse-power on the average per annum, the capital involved must not exceed £52 per horse-power, or £260,000 in all.

To conclude, it has been said that the greatest benefactor to the human race is he who makes two blades of grass to sprout where only one grew before. On this principle the utilization of natural water-power is obviously to the public advantage. When mechanical or electrical energy is generated by the burning of coal, it is a matter of the consumption not of interest, but of capital. On the other hand, every water horse-power that is put to use is something added, mundanely speaking, for all time, to the permanent resources of mankind.

THE VIGILANT FEED WATER REGULATOR.

Boiler owners seldom realize the enormous amount of energy stored in a boiler charged with the average steam pressure, unless they have seen the havoc from a boiler explosion. At the present time with the large factor of safety with which they are designed, and the careful yearly inspections most boilers are submitted to, it may safely be said that the predominating cause of explosions of this type nowadays is low water. It is not to be understood by this that the water is always permitted to become so low as to allow burning the crown sheets. But the water is permitted such a varied range in the boiler by letting it run pretty low, then filling it to the limit of safety, that the material is subjected to the widest possible variations in expansion and contraction. This action going on from day to day finally terminates in a rupture of greater or less degree; hence the value of maintaining a fixed water line.

To ensure a fixed water level in boilers the Chaplin-Fulton Manufacturing Co., Pittsburg, Pa., have placed upon the market the Vigilant Feed Water Regulator. This appliance not only maintains a fixed water line, but does it automatically. The principle on which the apparatus is based is the difference in weight between a body suspended in steam and suspended in water, which is, of course, equal to the weight of the water it displaces. The regulator consists of three parts. The first is a special bent brass nipple and gate valve, which is screwed into the water column at the point you wish to carry your water level. From that a three-eighths inch pipe connection is made to the top of the hooded chamber. The second part of the apparatus is a hooded chamber as shown. This is placed as close to the column as possible, with the bottom of the chamber eight inches to ten inches above the point at which you desire to carry the water level. A 1¼ in. connection is made from the bottom of the chamber to the boiler or to the bottom connection to the water column. On the top of the hood is a small pet cock for blowing out any accumulation of air. Inside the chamber is suspended a weight which is hung from the end of a lever, whose fulcrum is a shaft, one end of which extends through a stuffing box, while the other rests on a step inside. To the projecting end of this shaft is keyed another lever, which carries an adjustable counterweight, and at the fulcrum has a shoe with an adjustable set screw for lifting the stem of the actuating valve. This valve is attached to the top of the hood, and a steam connection made to the gauge pipe or other point where dry steam may be obtained. The valve has an upper and lower seat so arranged that when against the upper seat the steam connection is shut and the bottom one is open to the atmosphere. When seated on the bottom seat the connection to the air is shut and the steam pressure is admitted to the controlling valve. The controlling valve is the third part of the regulator, and is placed in the feed line to the boiler. In construction it is similar to a check valve, and the entering water tends to lift the valve. A stem extends from the valve through a stuffing box to a hood, which has



Vigilant Feed Water Regulator.

a mushroom top on which rests a diaphragm. The cap above the diaphragm forms a reservoir for water, which prevents the hot steam reaching the rubber diaphragm and burning it. Under the mushroom is a spring which tends to open the valve when there is no pressure on the diaphragm. When the water level is below the opening of the special nipple the regulator chamber will be full of steam and the water in the pipe to the chamber will be the same height as in the column. The weight in the chamber is then heavier than the counter-weight, and the latter will be in the top position and the actuating valve held against its top seat, and the exhaust will be open to the air. There can then be no pressure on the diaphragm, and the controlling valve will be wide open and the boiler taking water. When the boiler fills up to the opening of the special nipple the steam will be cut off from entering the chamber, and the steam which was in it condenses and makes a vacuum so that the water from the boiler instantly fills it to the top. The inside weight then weighs less than it did when it hung in steam by the weight of the water which it displaces. The counterweight is now heavy enough to over-balance the inside weight and goes down, while the inside weight goes up. As the inside lever goes up the actuating valve goes down, opening the steam connection and shutting the exhaust. This admits the steam pressure to the diaphragm chamber and forces the controlling valve down, so that the feed-water is shut off at once. No more water can enter the boiler until the water level falls to the opening of the special nipple, when steam is admitted to the top of the chamber, the water in it falls to the old level, all the operations are reversed and the controlling valve opens again. These operations are repeated as the water gets above or below the desired point, and the variation does not exceed one-half inch. The agents in Canada for this feed water regulator are the Fairbanks Co., Montreal, Toronto, and Winnipeg.

ODESSA WATERWORKS.

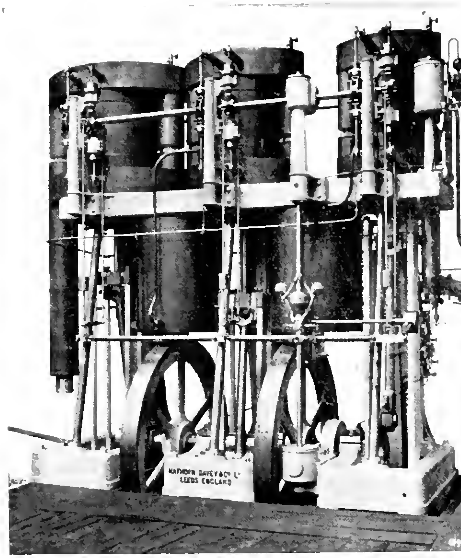
When the Odessa municipality purchased the waterworks from a private company, they retained the services of J. J. Platts, the late manager, as consulting engineer, together with his officials, and appointed Mr. Dmitrieff as chairman of the Waterworks Council.

Mr. Dmitrieff at once initiated, under the advice of the consulting engineer, a large scheme for extension of modern lines, which has been successfully carried out. The old plant, which was put down some years ago and has been added to from time to time, draws its water from the river Dniester, where it is filtered and pumped to Odessa through about twenty-eight miles of 30-in. main; it is then re-pumped into the service mains to supply the higher parts of the town. The new extension is to supplement the old plant with the most modern and economical machinery, and consists of a town pumping station with

covered reservoirs, situated in Chumka, a suburb of Odessa; a river pumping station with settling tanks and filter beds, situated at Beleivka on the river Dniester, with a new 30-in. main from Dniester to Odessa. The Chumka pumping station contains: Four triple expansion, inverted, vertical, Corliss pumping engines, made by Hathorn, Davey & Co., Limited, Leeds, England, each having cylinders 15-in., 25-in., and 40-in. in diameter, and three single acting ram pumps 18½-in. in diameter, all by 3 feet stroke, each capable of pumping five and one-half million gallons in 24 hours from the covered reservoirs direct into the service main, against a mean head of 160 feet, together with feed heaters, economizers and five Lancashire boilers, was officially opened May 20th, 1901.

The Dniester pumping station contains: Three triple expansion, inverted, vertical, Corliss pumping engines, made by Hathorn, Davey & Co., Limited, each having cylinders 20-in., 36-in., and 54-in. in diameter, and three single acting rams 17-in. in diameter, all by 3-ft. 6-in. stroke, each capable of pumping five and one-half million gallons in twenty-four hours, against a head of from 380 ft. to 460 ft., including friction through twenty-eight miles of 30-in. main, with steam at 180 lbs.' pressure.

Filter Engines.—Two triple expansion, inverted, vertical, Corliss pumping engines, made by the same firm, each having cylinders 12-in., 20-in., and 31-in. in diameter, and three single acting rams 32-in. in diameter, all by 2-ft. 6-in. stroke, each capable of pumping twelve million gallons in twenty-four hours, against a head of 35 ft., including friction, with steam at 180



lbs.' pressure. There are five feed heaters, two Green's economizers, eight Babcock water tube boilers, fitted with superheaters. The steam and feed pipes are on the ring system, and the whole plant is so arranged that any unit can be stopped without interfering with the working of the rest of the plant. Russian coal is used, which costs 24s. per ton, delivered at the pumping station

With respect to the comparative duty of the old and new pumping plants, the following figures, which are a fair average of every-day working, have been furnished us by the engineering manager, Theodore Platts:

Week ending June 20th, 1903.

Duty in foot pounds per pood (36 lbs. of coal.)

Old engines	16,880,700
New engines	34,271,000

This is equivalent to a duty of 52,517,733 foot pounds and 106,620,888 foot pounds, respectively, by the English standard of measurement.

Head pumped against old engines	323.17 feet.
Head pumped against new engines	314.74 feet.

The difference in the heads pumped against by the old and new engines is accounted for by having a clean main in the case of the latter, but this difference is taken into account in the duty, the measure of work done being in foot pounds.

All the engines were guaranteed by the makers to use not more than 16 lbs. of steam per pump horse-power per hour, and all of them have now been officially tested and are well within the specified guarantee.

Hathorn, Davey & Co. are represented in Canada by Peacock Bros., engineers, Canada Life Building, Montreal.

THE ST. LOUIS EXPOSITION SERVICE PLANT.

The contract for the main service plant for the Louisiana Purchase Exposition was awarded to the Westinghouse Electric and Manufacturing Company shortly after the plans for the Exposition had assumed final form. It called for the designing, installation and equipment of a complete central station to supply electric power for general use throughout the Fair—for the night illumination of the 1,240 acres and countless buildings of the Forest City, for pumping the water for lagoons and court basins, cascades and fountains, for operating exhibits and concessions in various parts of the grounds. The entire steam and electric station was designed and installed by Westinghouse, Church, Kerr & Company, and constitutes a plant of 14,000 horse-power capacity, representative of thoroughly modern practice at minimum cost, such as may be seen in only a few large cities. The four 3,500 horse-power Westinghouse-Corliss vertical cross-compound reciprocating engines at the west end of Machinery Hall, the smaller engines driving exciters in Machinery Hall, the engines driving pumps, stokers, and cooling tower fans in the service plant section of the Steam, Gas and Fuels Building, or Boiler House, just west of Machinery Hall, and the mechanical stokers in the latter building were manufactured by the Westinghouse Machine Company. The auxiliary electric apparatus and switchboard equipment was supplied by the Westinghouse Electric and Manufacturing Company.

The plant has been in continuous operation since April 15th, maintaining its own load, and from time to time carrying extra loads which exhibit plants have been unable to sustain. The station records show the exacting character of service rendered and the number of hours run.

The progress achieved in the manufacture of electric generating units of great capacity has been a very important feature of mechanical and electrical engineering since the time of the World's Columbian Exposition. The great central station at Chicago in 1893 was of about the same total capacity as the present plant, but the twelve generators, although then the largest polyphase alternating current machines ever constructed, were each of only 750 kilowatts, or 1,000 horse-power capacity, while to-day the four 3,500 horse-power units of the Louisiana Purchase Exposition service plant, although three times as large as the largest at Chicago, are regarded as of only medium size. The Westinghouse Electric and Manufacturing Company now has under construction generators for the Ontario Power Company of 10,000 kilowatts, or about 13,500 horse-power capacity, and steam turbines are being built in sizes up to 10,000 horse-power. It is interesting to note that the floor space occupied by the Westinghouse-Corliss engines and their direct-connected generators in the present Exposition service plant, 15 by 35 feet each, is proportionately only about one-ninth of that required at Chicago for six of the twelve 1,000 horse-power generating units there which were belt-driven, each of the latter, with only one-third the capacity of the present units, covering a space 27 by 65 feet.

The Exposition service plant, although it furnishes the main source of power for the world's greatest Fair, and carries all of the commercial operating and lighting load on the grounds and Pike, as well as a large part of the decorative night illumination of the main exhibit buildings, is of interest to engineers not so much for its size as for its completeness.

The Switchboard.

Electric current from the Exposition service plant and from exhibit power plants in Machinery Hall is transmitted

over the network of underground cables at a potential of 6,000 volts, transformers being used only at distributing points. All Exposition power is controlled from the twenty-nine-panel marble switchboard on the upper gallery over the west end of the main aisle. The electrically operated oil switches are behind the operating panels, the busses and instruments on the lower gallery, busses being in duplicate, and housed in a structure of masonry with intermediate barriers. All main generator and feeder switches are installed in independent fire-proof vaults, and are electrically operated from the main panel, indicators showing whether a switch is open or closed. Remote control of high tension current is exclusively employed, the switchboard being supplied with high tension, oil-immersed, automatic circuit-breakers, and with ammeters and voltmeters for each space.

Starting the Cascades.

The three 2,000 horse-power Westinghouse induction motors which operate the cascades pumps, estimated to have a capacity of 90,000 gallons of water a minute, are started very gradually at the advertised hours throughout the day and evening, the current being slowly raised to normal, the starting rheostats under Festival Hall, because of the exceptionally large size of the motors, having very many steps. Integrating and indicating wattmeters at the ends of the cables in Machinery Hall record the motor load when the cascades are in operation.

Generating Units.

The four main units are alike in capacity and general design. The engines are of the vertical "cross-compound" type, built vertical to economize floor space, and compound

Canadian Booth in Westinghouse Street of Nations, Palace of Machinery.

in order to secure greater economy of steam, and operate at a speed of eighty-five revolutions a minute. As the generator and flywheel are mounted between cylinders, a connecting "receiver" is necessary, which is built of riveted boiler steel plate, and conducts the exhaust steam from the high pressure cylinder to the inlet of the low pressure cylinder. Bed plates, one on each side, support in order the journals, engine frames, cross-head guides, and cylinders. The shaft, which is nearly three feet in diameter at the centre, is forged hollow from open hearth steel, fluid-compressed to ensure perfect homogeneity of metal. On account of the long span the bearings are self-aligning, having spherical instead of cylindrical seats, resembling the ball and socket arrangement, this permitting slight flexure of the shaft, due to the load concentrated at the centre. Both the bearing shells and the [illegible] water cooling.

Rocking valves of the [illegible] in the cylinder heads, which [illegible] paralleling the cylinder walls [illegible] inlet and a toggle motion on the [illegible] valves. The gear permits a [illegible] quarter stroke, enabling each engine [illegible] periods a load of 5,000 horse-power [illegible] is controlled by an enclosed type [illegible] governor, adjustable while running [illegible] sensitiveness.

In order to operate the generators in multiple a small motor is provided at the engine, which moves an adjustable weight on the governor mechanism. The motor is controlled from the switchboard, so that the engine speed may be adjusted until the incoming generator has been synchronized and connected to the system. An automatic speed limit is provided on the engines, which instantly closes the throttle should the safe speed be exceeded through breakage of the governor mechanism. This mechanism may be operated also by the engineer from the main floor by means of an electric switch.

The generators, which are rated at 2,000 kilowatts at the usual temperature rise, are of the engine type, revolving field construction, with laminated armatures and fields, the armatures strap wound in partially closed slots, and the fields wound with copper strap on edge. In order to obtain access to the winding the entire generator frame may be moved out of position parallel to the shaft. Three 80 kilowatt, 125-volt Westinghouse engine type units furnish exciting current for the generator fields.

Condensing System.

All main and exciter engines, as well as auxiliaries in Machinery Hall, operate condensing, two complete central condensing equipments being installed, each of 7,000 horse-power capacity, and serving one-half of the plant. They are of the Worthington elevated jet or "barometric" type, provided with entrainers and rotative "dry air" pumps for removing air from the condenser cones. Both horizontal and vertical types of pumps are in operation, one of the three being held in reserve. In case of loss of vacuum an automatic relief valve allows the exhaust steam from the engine to escape through the roof. A motor-driven valve, operated from the floor below by a switch, controls the steam inlet to each condenser. Circulating water is supplied to the condensers by a centrifugal pump of the Worthington turbine pattern, direct driven by compound engine. The hot water discharged into the condenser hot wells is not thrown away, but is cooled for further use in four specially designed cooling towers adjacent to the boiler-room. A second turbine circulating pump elevates the hot water into the towers, and, in falling, the temperature is reduced by evaporation, which process is further aided by forced draft from the fans located at the base of each tower and driven from the boiler-room by a Westinghouse compound engine. A third turbine pump unit is held in reserve, and may be employed on either condensers or cooling towers. Motor driven valves operated by a switch from the floor control the outlet of each pump.

Steam System.

Two complete systems of steam mains, twelve inches in diameter, convey steam to the main engines. The mains are carried beneath the floor in pipe galleries, anchored firmly to prevent creeping, and supported upon rollers to accommodate expansion and contraction. Entrained water collecting in the boiler-room piping is drained out and automatically returned to the boilers by a steam loop and gravity return, which may be seen in continuous operation in the boiler-room.

A similar system of piping for the boiler-room and pumping auxiliaries is connected to the boilers between the drums and main valves, so that steam is always available at the boiler-house auxiliaries. These operate non-con-

densing, exhausting into two open-feed water heaters, which reclaim the greater part of the heat from the exhaust. In the engine-room all auxiliaries operate, condensing upon the main condensing system.

Boilers.

Steam is furnished by sixteen 400 horse-power Babcock & Wilcox water-tube boilers of the forged header type, set two boilers in a battery. The tubes and drums are carried by steel frames independent of the brick setting. Two ten-inch loop steam mains, each connecting four batteries of boilers, deliver steam to the two twelve-inch mains which carry the steam to the main units in Machinery Hall.

Mechanical Draft.

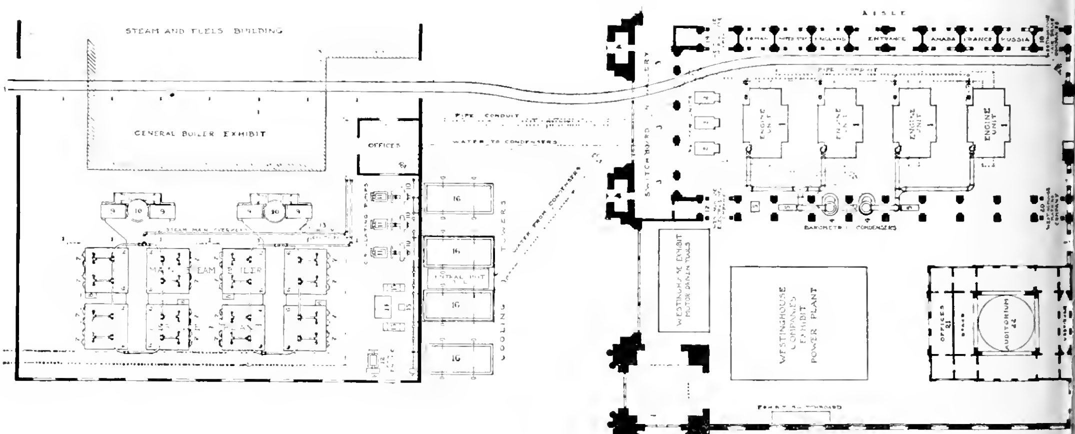
Each group of four batteries of boilers is served by an independent induced mechanical draft equipment. Each equipment is provided with two fans, each capable of operating the boilers at their full capacity. A damper, by means of which either bar may be cut in or out of service, is so arranged that, if desired, both fans may be run simultaneously.

Key to Numbers on Chart.

1. Main Generating Units—Four engines: Diameter of high pressure cylinder, 38 inches. Diameter of low pressure cylinder, 76 inches. Stroke, 54 inches. Shaft, 31 inches diameter and 25 feet in length; fluid compressed open hearth steel; weight, 50,600 pounds. Fly-wheel, 23 feet diameter; weight, 170,000 pounds. Speed, 85 revolutions per minute. Boiler pressure, 150 pounds. Vacuum, 26 inches. Cranks, counter-balanced disc, 90 degrees angularity. Fly-wheel effect, 13,110,000 pounds. Weight engine, without fly-wheel, 576,000 pounds. Weight engine, with fly-wheel, 746,000 pounds. Four generators: 2,000 kilowatt, revolving field, engine type, three-phase; voltage, 6,600. Frequency, 25 cycles per second. Overload capacity, 50 per cent. for one hour. Total weight, complete, 196,000 pounds. Units: Length, 35 feet 1 inch. Width of engine bed, 15 feet. Height of engine, 32 feet 4 inches. Total weight of unit, 942,000 pounds.

2. Exciter Units—Three 80 kilowatt, 6-pole, 125-volt generators, direct connected to three 12 inch and 20 inches and 12 inches Westinghouse compound engines, 300 revolutions per minute, operating condensing.

3. Switchboard—Twenty-nine panels; electrically operated oil switches; remote control.



Mechanical Stokers.

The firing of the boiler plant is accomplished by mechanical stokers, each group of four stokers in line being driven by a small engine, through suitable gearing. The stoker embodies the principle of the narrow rocking grate, stepped at such an angle as to facilitate a uniform descent of fuel from the coking arch at the top to the dumping gate at the bottom; the coking arch, which embodies the principle of the reverberatory furnace, being highly instrumental in securing perfect combustion of the volatile distillates contained in bituminous coal. On the Exhibition grounds the production of smoke is discountenanced, and careful observations of the smoke from the stoker chimneys are made at intervals during the day's run for purposes of comparative record.

Travelling Crane.

In the design of the service plant no important feature of a modern central station was omitted. The electric travelling crane over the main engine units in Machinery Hall is of forty tons carrying capacity, and bridges a span of eighty feet. It is equipped with three motors—one, of 20 horse-power capacity, to drive the bridge, being located at about the centre of the girder, and two, one of 20 horse-power capacity for hoisting and one of five horse-power for moving the trolley, being secured to the trolley itself. The motors are controlled from the crane cab, and current at 110 volts is supplied from the exciters for the main engine units.

4. Barometric Condensers—Forty-inch elevated jet or barometric type, supplied with injection water by a 30-inch main from circulating pumps; overflow from hot wells returned to circulating pumps by wood conduit; main valves operated from floor by electric motors.

5. Dry-air Pumps—One vertical, single-stage, rotative type; steam cylinder, 8 inches and 12 inches; air cylinder, 16 inches and 12 inches. Two horizontal, single-stage, rotative type; steam cylinder, 10 inches diameter and 18 inches stroke; air cylinder, 22 inches diameter and 18 inches stroke; pumps operate condensing.

6. Sixteen Boilers—Water tube type, inclined forged steel header; rated capacity, 400 horse-power each.

7. Mechanical Stokers—Two stokers to each battery; receive coal from overhead hoppers, supplied by general conveying system; ashes removed through basement to elevator.

8. Four Stoker Engines—Westinghouse enclosed, self-lubricating, each engine driving stokers on two adjacent batteries of boilers.

9. Mechanical Draft Plant—Two complete plants. Four fans, in pairs, three-quarter housed, over-hung type, operating on the inductive principle, the fan wheel being mounted on the engine shaft.

10. Centrifugal Circulating Pumps—Three direct driven, turbine type, 24 inch discharge; capacity of each, 17,000 gallons per minute under a 50 foot total head.

11. Circulating Pump Engines — Three single-acting, compound type, 18 inches and 30 inches and 16 inches; governor arranged to vary speed according to pump output.

12. Fan engine for cooling towers.

13. Steam loop and Holly gravity return system.

14. Feed Water Heaters—Receive exhaust steam from all boiler-room auxiliaries.

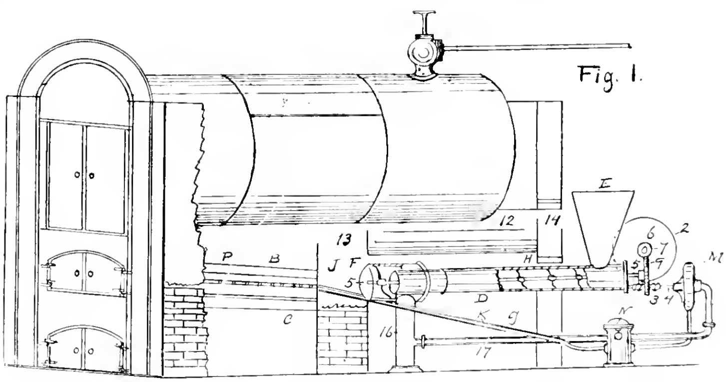
15. Boiler Feed Pumps—Steam cylinder, 14 inches by 18 inches; water cylinder, 10 inches by 18 inches. Two horizontal, compound, duplex, outside packed plunger type; steam cylinders, 9 and 16 inches in diameter by 15 inches stroke; water plungers, 7½ inches diameter by 15 inches stroke.

16. Forced Draught Cooling Towers—Effective area of each tower, 400 square feet, each equipped with four 120-inch disc fans; "make-up" water, replacing the amount evaporated, is supplied from city mains.

17 to 22. Information bureaus, general offices, and Biograph Auditorium.

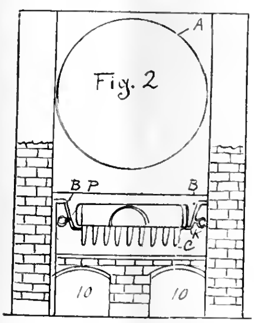
IMPROVEMENTS IN FURNACE FEEDING.

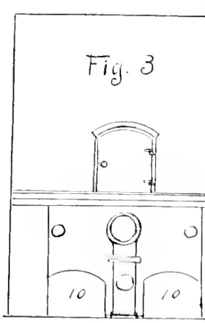
Robert Baker, of Hamilton, Ont., has obtained patents in Canada, Great Britain and the United States for a stoking and fuel-saving device which appears to combine two important advances in furnace feeding and in completeness of combustion of fuel. So far as we have heard, this is the first machine of the kind which works with natural draft, and it is the first which combines with a stoking apparatus a gas generating plant and retort for saving the by-products of coal. The invention is described as follows:



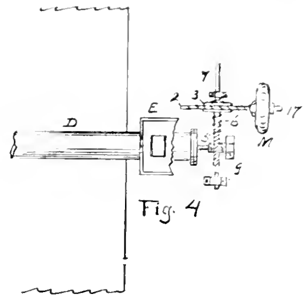
The Baker Stoker and Fuel Saver.

The draft is taken at the rear of the boiler through an opening beneath the curved flue and picks up the latent heat, increasing the volume, which flows through the two arches in the bridge wall to the ash pit, then through the fire which is upon the grates; then over the bridge wall and through the flue to the combustion chamber and on through the tubes distributing the heat to the boiler. The grate bars are of the ordinary type and are set inclined to the bridge wall, and have inclined sides with perforations for the admission of the gases.





The ash pit is provided with a receiver for water of the full area of the pit and is fed automatically at a constant level. The coal is fed into a hopper by means of a bunker and conveyed from thence by a spiral feed device to the generating chamber in the bridge wall where it is prepared [illegible] coal for the grates. The gases are conveyed rearward by means of a fan, and in their course deposit their impurities in liquid form—as is done in the manufacture of illuminating gas—into a receiver; thence forward to the back of the inclined



sides, depositing the gases in opposite directions through the perforations to the fire, where they are consumed.

The engine that drives this appliance has double cylinders, and is set on quarter-crank motion. The draining of the cylinders is trapped with an expansion trap to relieve the condensation. The fan is geared from the shaft of the engine by means of a large spiral gear wheel running into a smaller one on the shaft of the fan. The shaft engine extends to the spiral coal feeder with a large spiral wheel on the shaft of the coal feeding apparatus, and a small one on the engine shaft. The coal is continually being prepared and conveyed forward on to the grates at full grate area, and at the same time the carbonic acid is deposited into the ash pit. The live coals are conveyed to the full length of the grate area, and the ashes therefrom are deposited on the dead plate. This arrangement keeps the grates perfectly clean, as it makes no clinkers, all impurities having now been deposited. The ashes can be cleaned from the front when necessary without disturbing the fire. The fire and ash pit doors are kept closed until the deposits are required to be removed, therefore no cold air can be admitted to the boiler.

This machine is controlled by a damper regulator. When a given pressure is obtained, the dampers readily close, the engine is shut down, and the bye pass is opened for the gases to flow to the grates by gravitation. When the pressure falls, the dampers readily open and the bye pass closes and the engine is set in motion. This being a completely automatic machine, no attendance is required through the night, nor any banking of fires. Simply set the dampers to the pressure required to be carried through the night. When the engineer comes in for duty in the morning he sees that the water is all right in the boiler, then he goes to his damper regulator and sets it at the desired pressure to be carried through the day. He then may oil his engine and attend to any other necessary duties. He will then find the steam up and all ready for starting up without any further attention.

BOILER EXPLOSION AT TORONTO.

On September 14th, a boiler exploded in the Toronto Bolt and Forging Co.'s rolling mill at Sunnyside. Two men have lost their lives and five are more or less injured. The boiler was built about two years ago by the Canadian Heine Safety Boiler Co., and had been inspected and found in good condition in July. It weighed about four tons and was lifted from its foundation and landed end for end just beside its original location. The impact brought down the 65-foot iron smoke-stack, and this crashing through the roof caused most of the property damage.

This is one of the few cases in which the cause of the explosion is perfectly clear, namely, low water. An examination of the boiler afterward showed the water-line to have been at a height of about fourteen inches, the plates having been red-hot above this line. The excellence of the material in the plates is shown by the fact that before splitting they were stretched to a knife-edge thickness at the point of rupture. The tear in the plates was about four feet long just above the water-line.

The superintendent and others testified that just before the explosion the gauge-glass showed water to a good height, but investigation showed that the gauge glass was disconnected from the boiler, the valve at the lower end being found tightly closed. How it came that this valve should be closed will never be known, as Engineer Dixon, the man in full charge of the water feed, has died of his injuries. The most probable explanation seems to be that he had blown out the gauge glass and had forgotten to open the valve, and that afterward the glass had partially filled from condensation.

A brass plug in the pet cock had been lost and had been temporarily replaced with a wooden plug, but it is not thought that this had any necessary connection with the explosion, as the fact that the valve was closed fully accounts for the false indication of the gauge glass.

It has been suggested that the explosion would not have been so violent if the boiler had not been connected with the other boilers.

The coroner's jury found that John Dixon came to his death by the explosion of a steam boiler, caused by the lowness of water and also that the wooden plug used was not the proper thing for a water gauge.

EUROPEAN ELECTRICIANS VISIT CANADA.

Electricians from Britain, France, Germany, Spain and Italy paid Canada a flying visit last month on their way to the International Electrical Congress in St. Louis. The party, accompanied by a few delegates from the United States, and from South America, spent two days, September 7th and 8th, in and around Montreal. Lachine was visited; the rapids were shot; the main sub-station of the Montreal Light, Heat and Power Co. was investigated, where amidst the hum of electric monsters the visitors enjoyed a lunch served by the Light, Heat and Power Co. Trips around Montreal were taken by trolley and otherwise, and the first day was closed with a garden party given by the Forest and Stream Club at Dorval. The second day was occupied with a trip to Shawinigan Falls, where the party was entertained by the Shawinigan Water and Power Co. In the evening the delegation left by special train for Niagara Falls, whence, after a short visit, they departed for St. Louis.

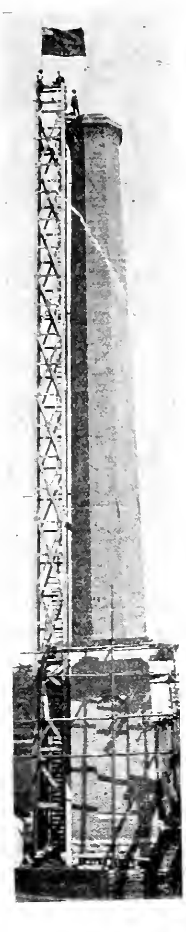
Following are the names of the visiting members of the Institute of Electrical Engineers of Great Britain: R. Kaye Gray, president; Col. R. E. Crompton, C.B., past president; Prof John Perry, past president; C. H. Merz, member of council; R. Hammond, honorary treasurer; G C. Lloyd, secretary, and A F. T. Atchison, Francis G Baily, G. Balfour, R. S. Ball, W. A. Barnes, D Bates, Fred. Beanland, G Conrad Blair, John T. Connolly, Prof. J D. Cormack, C. B. Crawshaw, J. R. Dick, W Duddell, R. S. Erskine, W. P. J. Faweus, Theo. Feilden, J. A Foster, W. Geipel, W A. Harris, Charles C. Hawkins, M. Hayashi, Thomas Hesketh, F. Hope-Jones, M. Jennison, F. C. Kidman, L. Lehurann, Emil H. Liebert, F. M. Long, Benjamin Longbottom, R B. Matthews, R. S. McLeod, John L. Marr, W. B Marr, G F Metzger, F. O. Milis, D. K. Morris, John T. Morris, R. W. Paul, Robert B Perring, Godfrey Pope, A. P Pyne, G H. C. Risch, E. N. Sawtelle, A. P. Scott, E. M. Sconer, M. W. Scott, H. B. Simons, P. S. Sheardown, C. D. Taite, Max E. J. Tilney, J. H. Tonge, R. Tree, chief clerk; George Wilkinson, R. Ffolliott Wiliss, E. B. Wollan, and H. G. Whiting.

R. Kaye Gray, president of the Institution, spoke for the British delegates at the reception tendered. He expressed himself as deeply interested in all he had seen, and was pleased to find Canada a country vast in project and achievement. He reports England very much alive in matters electrical; he admits that there may be development on this side surpassing that in the Old Land, but ideas worked out on this continent often originated across the water. There is a feeling in England that English suggestions may be left with others to develop, and then results be reaped by the English people. Britain is ready to adopt ideas from anywhere, but she always gives ideas in return.

Jorge Newbury, general director of electrical works in Buenos Ayres, Argentina, was one of the party. He states that the electrical development of that city amounts now to about 30,000-h p.

Several Italians were among the visitors, including Professor Ascoli, one of the Government delegates. Italian, Spanish, French and other tongues were heard in the party, but no lingual difficulty was experienced, as all spoke and understood the harsher and less musical English.

CHIMNEY BUILDING FROM A DERRICK.



The accompanying engraving is from a photograph of the brick chimney erected by R. Corrick & Sons, for the new plant of the Sarnia Gas and Electric Light Co. The chimney is of red brick, built on a concrete foundation 9 by 17 ft., and is 12 ft. 6 in. square at the base and continues the same form and dimensions to a height of twenty-eight feet. Above that it is of octagonal form ninety-seven feet high, with an outside diameter at the top of eleven feet and finished with a cement cap, making the total height from foundation, one hundred and twenty-five feet. It is provided with a double wall to the height of seventy four feet ten inches, twenty-eight feet of which is of fire brick, and the balance of ordinary brick between which and the outside wall there is ample air space. The inside diameter is practically six and one-half feet throughout the entire height. The derrick, as seen in the photograph, was built its entire height before the chimney was commenced, and all material was hoisted up inside it. It is one of the largest chimneys of its kind in Western Ontario.

—The A. Leschen & Sons Rope Co., of St. Louis, Mo., manufacturers of wire rope for all purposes, have issued a useful souvenir in the shape of a celluloid wire rope gauge, which will be sent free to users of wire rope.

A new post office and customs building is being erected at Sydney Mines, N.S., at a cost of about $18,000. James Reid has the contract.

NEW COAL AREAS ON THE C.P.R.

At Bienfait, about ten miles east of Estevan, on the Souris branch of the Canadian Pacific Railway, mines are being opened which will be capable of turning out, when fully developed, 1,000 tons of lignite coal per day. As at this point the coal lies within 70 feet of the surface and quite flat, and with a dip of about 1 degree to the south, an incline or slope is being used in place of a shaft. The thickness of the seam at this point is 15 feet, but only the bottom 7 feet will be mined. This class of fuel, which is somewhat better than that found in Dakota, is used almost entirely by the farmers throughout the wheat districts of the North-West Territories and Manitoba. It is also used by the largest milling companies, being cheaper than either the high-priced coal from the East or the coals from Alberta and British Columbia.

Two seams of semi-anthracite coal are also being developed at a point six miles east of Banff, Alberta. The two seams average, respectively, seven and eight feet, dipping 45 degrees to the west. The seams have been explored for a distance of seven or eight miles north, and the measures as a whole comprise some six workable seams in a distance of 2,000 feet at right angles to the dip. Some of the upper seams are semi-bituminous. The two lower semi-anthracite seams, on which all of the present development work is now being performed, are found in the hard, cretaceous sand stone. The upper measures are in softer shales and sand stones, which is supposed to be the explanation for the upper seams being semi-bituminous instead of semi-anthracite. A gravel entry 22 ft. by 9 ft., consisting of three compartments, is now being run a distance of 1,600 ft. to connect with the present underground workings. At a distance of one and one-half to two miles from the mouth of the entry, there will be a total height of about 2,000 feet of coal. It is, therefore, not intended to sink for some years. As the practice throughout Western Canada has been to use wood, lignite or bituminous coal for both domestic and steam purposes, it will require some time to develop a very large market in the West, but it is expected that within two or three years the product will supply the domestic trade from Winnipeg to Vancouver. It is also quite possible that this fuel will be marketed to advantage in the Pacific Coast cities, where a large market will be available.

The analysis of the clean coal is about as follows:

Fixed carbon	84 per cent.
Volatile matter	9 " "
Moisture	1 " "
Ash	6 " "
	100 " "

The clean semi-bituminous coal analyzes about as follows:

Fixed carbon	78 per cent.
Volatile matter	14 " "
Moisture	1 " "
Ash	7 " "
	100 " "

The semi-anthracite coal burns more freely than the Pennsylvania product, and is a little more brittle. The semi-bituminous is excellent steam coal. The ash in regular shipments will probably run 12 to 14 per cent. At present, the coal is being hand picked, but it is expected to install some of the latest mechanical picking devices as soon as experiments with the various forms of mechanical pickers have been completed.

The standard Pennsylvania sizes of anthracite are now being produced as follows:

Lump, passes over	3¼" round holes
Egg, passes over	2¼" " "
Stove, passes over	1½" " "
Nut, passes over,	7/8" " "
Pea, passes over	9/16" " "
No. 1, buckwheat, passes over	5/16" " "
No. 2 buckwheat passes over	3/16" " "

The plant will be equipped with four 150-h.p. Robb Engineering Company's boilers, a 15 drill air compressor, and also a high pressure compressor for compressed air haulage. Thirty or forty miners' cottages are being built this summer, and a large number will be completed next summer. Several boarding houses are also under way. A complete fire, water and drainage system will soon be installed. All these mines are owned and operated by the Canadian Pacific Railway.

COMPARATIVE COST OF WOOD AND STEEL FRAME FACTORY BUILDINGS.

H. G. Tyrrell, chief engineer of the Brackett Bridge Co., Cincinnati, sends us the following comparison of the cost of wood and steel in factory buildings. There are differences in the cost of material in Canada and the United States, but the comparison will, nevertheless, be instructive to our readers:

The following estimates give the comparative costs of a factory building, framed in slow burning wood construction, and steel fireproof construction. The building is 60 by 100 ft., and six stories high, containing six floors and roof. The floors are designed to carry an imposed load of 100 pounds per square foot. The building has windows in all four sides and the walls in both cases carry the ends of the floor beams. The thickness of walls in the basement is 21 inches, while in the first four stories it is 17 inches. In the remaining two stories the wall is 13 inches thick. The estimates given below, are for the structural part of the building only, including walls, columns, floors, roof, excavation, doors and windows, foundations, but do not include any partitions, stairs, elevator, plumbing, heating, lighting or wiring.

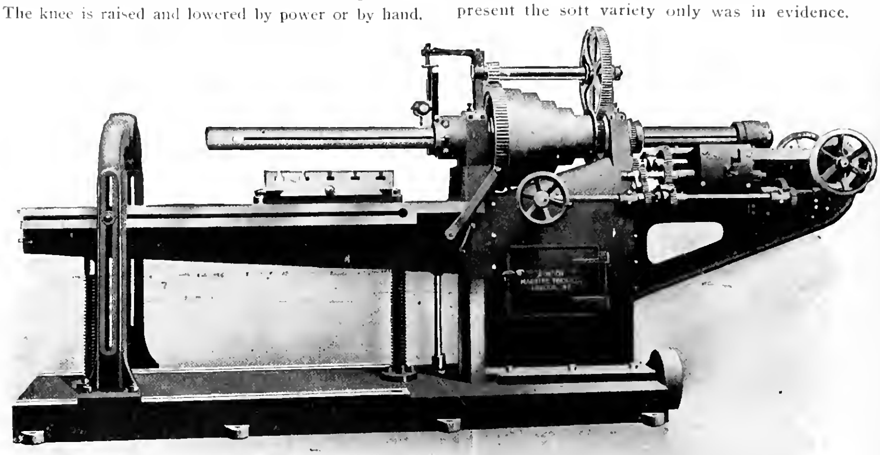
The framing of the slow burning design is as follows: Eight tiers of columns, spaced 20 feet apart in both directions, carry the floors and roof. From the roof down through four stories, the columns are of yellow pine. In the lowest of these stories the size of column used is 14 by 14. Below this, where a greater size would be required than can be secured economically, round cast iron columns have been used, 11 by 1¼ in the first story, and 12 by 1½ in the basement. All the columns have cast iron bases, three feet square and 16 inches high. Lengthwise through the building in the floors, run two lines of 12 by 20-inch yellow pine, which rest on the brackets of cast iron column caps. The cross floor beams are 8 by 16 yellow pine spaced 5 feet apart. At the columns they rest on column caps, and at intermediate points they hang from the 12 by 20 header beams by means of wrought iron stirrups. In the walls the cross floor beams rest on cast iron wall plates, 9 by 20 by ¾. The floor is made of ⅞-inch matched maple, laid on 1¾ yellow pine. The roof is similar in construction and has a tar and gravel covering. The quantities of material in the building, as outlined above, are as follows: Excavation, 1,800 yards; cellar, cement floor, 6,000 sq. ft.; foundation, concrete, 150 cub. yards; brick, 30,000 cub. ft.; 238 windows, 4 by 7 ft.; roofing, 6,000 sq. ft.; yellow pine timber, 110,000 ft. B.M.; yellow pine flooring, 73,000 ft., B.M.; ⅞-in. matched flooring, 46,000 ft., B.M.; iron work, 46 tons. The estimated cost of this design is $35,000, which is equivalent to 6.1 cents per cub. foot of the building, or 83 cents per square foot of the entire area of all the floors. The interior framing of floors and columns, including wall plates, columns, caps and bases and stirrup irons, is 27 cents per square foot of floor area.

In the fireproof design, the arrangement of beams and columns is similar to that for the slow burning design. Riveted steel columns are used from cellar to roof, and the floors are framed with steel beams. The flooring between the beams is reinforced concrete. In this case the quantities are as follows: Excavation, 1,800 cub. yards; cellar floor, 6,000 sq. ft.; foundadation, concrete, 150 cub. yards; brick, 30,000 cub. ft.; 238 windows, 4 by 7 ft.; roofing, 6,000 sq. ft.; steel columns, 105 tons; steel beams and wall plates, 252 tons; concrete, floor and roof, 42,000 sq. ft. The cost of the building in this case is $57,000, which corresponds to 10.2 cents per cubic foot of building, or $1.36 per square foot of the total floor area. Floors and columns cost 75 cents per square foot of floor area. Hence the comparative estimates are as follows:

	Cost per Cub. Ft. of Building	Cost per Sq. Ft. Floor Area	Cost of Floors and Cols., Sq. Ft.	Total Cost.
Slow burning construction	6.2c	83c	27c	$35,000
Fireproof steel construction	10.2c	136c	75c	$75,000

NEW TYPE OF HORIZONTAL BORING MILL.

We herewith present a new type of horizontal boring mill, which has lately been put on the market. The capacity of the machine, as shown in the illustration, will bore up to five feet in diameter and six feet in length. The head is large and massive, having five speeds for four-inch belt, the largest diameter of cone being 23 inches, and being powerfully back geared gives ample power for the heaviest work, and permits of high speed steels being used to the best advantage. The boring bar is four inches in diameter, and has a feed of 36 inches, without shifting the driving pins. The feeds are reversible, are eight in number, ranging in geometrical progression from 1-128 inches per revolution of spindle to 5-16 inches. This provides a variation suitable for any class of work. The feeds can be thrown in and out while the machine is in operation from either side of the machine. Hand-feed and quick return is also provided. The table has movement, both crosswise and in a longitudinal direction. The knee is raised and lowered by power or by hand, as desired, the raising and lowering being accomplished by means of a worm and worm wheel placed underneath knee. A facing up to 26 inches' diameter. The total weight of the machine is 18,000 lbs. It is manufactured by the London Machine Tool Co., London, Ont., who will be pleased to furnish upon application any further information.



AN ANTHRACITE MOUNTAIN IN ALBERTA.

A mountain of hard coal in Alberta has recently been purchased by P. Burns & Co. for $32,000. From the Wetaskiwin Post we glean the following description of the location:

The property is in the Misty range, 36 miles west of Okotoks, Alta., and comprises 16,000 acres. It was discovered by an explorer, Julius Rickart, an old-time prospector. Mr. Patrick, D.L.S., and a party of surveyors spent several weeks in the district and made a thorough inspection of the coal seams as exposed in many tunnels made by the miners in the pass.

The situation of this phenomenal coal bed is most picturesque. Upon either side there tower huge, precipitous mountains thousands of feet high, and nestling in a valley is this mountain of coal, which is twelve miles long and three miles wide. Its formation differs vastly from that of the surrounding mountains, as it is covered with vegetation, while the others are bare limestone. For some time past miners have been engaged making tunnels into the mountain, and succeeded in exposing twenty-six veins of coal, which varied from four feet up to forty feet. Samples of this coal have been sent to assayers in Denver, Vancouver and other cities, and in every case remarkable reports were made. The assays run from 87 to 92 per cent. carbon. The following is the report received of the assay of the four-foot vein: Water, none; volatile matter, four per cent.; fixed carbon, 92 per cent.; sulphur, none; ashes, 4 per cent. The physical description is briefly given in the report: Color of ashes, white; weight per cubic yard, 2,680 pounds; specific gravity, 1.54. What particularly attracts attention is the total absence of rock, and of smoke in burning. The coal ignites easily, and from experience in burning it the assayers feel satisfied that it excels the well-known Pennsylvania variety.

The advantage of working this mine is a great consideration, as practically no machinery is needed for taking water out of the mine. Mr. Burns is highly elated with his purchase, and is of the opinion that it will develop into the largest mining camp in the Dominion. The whole of the country west is one huge bed of coal, but up to the present the soft variety only was in evidence.

—One of the principal difficulties in the economy of steam boiler operation in certain sections is incrustation. Its destructive effects have been the subject of such a wide amount of comment and warning that steam users might be presumed to be constantly on their guard to prevent it, but as a matter of fact, except in localities where the evil is so pronounced as to imperatively demand the adoption of preventive means, this subject is too commonly neglected. Unfortunately, the evils arising from this cause are often insidious, and do not make themselves manifest until substantial injury has occurred by the overheating and weakening of the boiler shell, or by effecting the crystallization, granulation, burning and fracture of the material, while wasting fuel. The extent of this waste is hardly appreciated until it is known that a 1-16-in. of scale in the boilers means an increase in the fuel bill of about 13 per cent. A standard remedy for the removal of scale, already deposited in boilers, as well as preventing its re-formation without injury to the boiler, is Keystone Tri-Sodium Phosphate. The most careful analysis by eminent chemists has shown that it is incapable of injuring the iron of the boiler. Where boilers are already coated with scale, its use gradually converts the stony incrustations of the carbonates of lime and magnesia, and even anhydrous sulphate of lime, into pulverent and flocculent phosphates. It also separates the foreign matter held in solution by the water as a light flocculent precipitate, which will not bake into a crystalline scale, but is easily removed by blowing off, thus preventing the formation of incrustation, and furthermore, it neutralizes acids contained in the water, thus rendering them innocuous. A sufficient quantity for testing this chemical will be sent to any Canadian manufacturer on mentioning the Canadian Engineer. Address: The Keystone Chemical Manufacturing Co., Camden, N.J.

A. C. vs. D. C. ARC SYSTEMS.

A Paper read by W. L. McFarlane before the Canadian Electrical Association.

(Concluded from August Issue).

Arc Lamps.

Having examined into the different arrangements of station apparatus, we now come to the lamps themselves, in the consideration of which we must pay due regard to the requirements or opinions of the customer or others depending on or using the light. Generally speaking, the systems available are the constant potential or multiple, used mainly for interior lighting, and the constant current or series, using both direct and alternating current, for street lighting. Multiple lamps are supplied for use on both alternating and direct current, but with few exceptions direct current for the operation of multiple lamps is not available in Canada; therefore, multiple A. C. lamps are all that need be considered here. These are of both the open and enclosed type, but the open lamp has not met with as much favor as the latter on account of the short life of the carbons, the poor quality of the light as compared with the D. C. lamp, its unreliability, and the noise made by the arc and lamp mechanism. The multiple enclosed lamp is much superior in this respect, the power factor also being better.

Multiple lamps are used mainly to supply customers' premises where the high voltage series arc system is objectionable, or the flat-rate charged for it does not meet with approval, as the multiple lamp can be charged for by meter, and supplied from the low potential lighting system. These lamps, being under control of the customer, permits of his using them at any time of the day or night. This is of great advantage during dull weather, or when the lamps are used in dark buildings or in basements. Then, in the case of long days or early closing, the customer is not compelled to pay for light which he does not need, as is the case when the series lamp is in use, and customers located beyond the reach of the series of commercial circuits are now as well supplied with light as those located nearer the station. The preference shown for the constant potential lamp for interior lighting is illustrated in the case of a plant which I have in mind, in which the commercial series constant current arc lamps connected are at present almost nil, where a few years ago they numbered almost 400; this in spite of the fact that the output of the plant in all other respects has increased enormously.

Constant current series lamps, either direct or alternating, give the best commercial satisfaction when they are of the differential rather than the shunt type. The direct current lamps are either open or enclosed. Open lamps cost about 15 per cent. less than the enclosed, and, owing to the E. M. F. of the former being about 50 volts as compared to 72 volts in the latter, there is a corresponding saving in the cost of the circuit insulation, etc. The enclosed direct current lamp is much more reliable than the open lamp, the maintenance of the lamps and the outages being reduced about 50 per cent. The most noticeable saving when enclosed lamps are used is in the operation, the cost of carbons and trimming being reduced nearly two-thirds. For mechanical reasons we cannot expect a saving in line copper to correspond with the difference in current required by the two styles of lamps, as No. 6 wire will probably be required in any case; there will, however, be a slight saving in the copper losses.

The enclosed A. C. series lamp, as far as reliability of service is concerned, compares favorably with the enclosed D. C. lamp; the cost of the lamp and the maintenance is slightly more, however, as there seems to be a greater tendency for the insulation of the A. C. lamp to become punctured. This I attribute to surging, resonance, or other high voltage conditions which occur on the circuit at times of grounds, short or open circuits, and believe that this trouble is reduced to a minimum by the use of suitable spark gaps connected across each lamp, as well as occasionally across the line. With the use of high voltage circuits comes the necessity of installing an absolute cut-out for each lamp as a protection against accidents to inspectors. Table No. 4 gives the approximate annual line costs of the three different types of series arc lamps. The costs, as stated above, are nearly equal for the two types of enclosed lamps, but the open lamp costs are nearly double that of the enclosed lamps.

Showing Comparative Approximate Annual Line Costs for Different Arc Lamps.

Items of Cost — Account	Sub-Account	Open D.C. Lamps	Enclosed D.C. Lamps	Enclosed A C Lamps
		$	$	$
Construction..	Reconstruction of Circuits	....	2550	2550
	Lamps	10000	11500	12500
	Total	10000	14050	15050
Maintenance..	Interest and Depreciation	1500	2107	2257
	Lamps	1000	500	750
Operation.....	Carbons	3285	700	800
	Trimming	3120	1040	1040
	Inspection	520	520	520
	Inner Globes	....	300	350
	Outer Globes	75	125	125
	Total	7000	2085	2835
Grand Total		9500	5202	5842

Illuminating Qualities.

The maximum candle power of the open arc is higher than that of the enclosed arc, but the light is not so steady owing to the more frequent feeding of the carbons, their poorer quality, and the action of the wind on the arc. Owing to the shortness of the open arc, and to the fact that most of the light comes from the crater of the upper carbon, this light is in a downward direction, being greatest at an angle of about 45 degrees, while a large area under the lamp is poorly lighted and affected by shadows. In the enclosed arc, the wandering of the arc is the main cause of what variation there is in the light, but by the use of an opal inner globe these variations are greatly reduced. The increased length of the enclosed arc allows the light to diffuse in a more horizontal direction, the result being much less light

in the immediate vicinity of the lamp, but a slightly increased amount midway between lamps. A comparison of the light given by the two enclosed arcs, namely, the direct current and the alternating current lamps will show that the former gives slightly more light at all points than the alternating lamp, although the alternating lamp gives more light than the open direct current lamp midway between lamps. It is claimed that "the difference in the light (at, say, 150 feet from the lamp) between the D. C. and the A. C. enclosed lamps is nearly, if not quite, compensated for on account of the more subdued light in the vicinity of the A. C. lamp increasing the relative effect of the light at a distance by reduced contrast." Whether this is so or not, the fact remains that the light given by the alternating lamp is apparently less than that given by the open D. C. lamp, and the apparent reduction in illuminating power is a very difficult point to explain satisfactorily to the municipal authorities or the public in general. It is only fair to say though that where an old style open direct current arc system has been replaced by a modern alternating enclosed system it is rare to find any serious opposition, especially so if the new system is properly handled and maintained. The possibility of such trouble need not, I think, deter anyone from installing modern equipment of this type if other conditions indicate that it is advisable to do so.

Summary of Costs.

As the factor which will determine the apparatus or system that shall be adopted, when the remodelling of an arc plant is under consideration, will most likely be the cost, it was thought that the placing of these costs in a convenient form might be useful, and this has been attempted in Table No. 5, as above:

Assumed Cost of Power.

60 Cycle Steam Power delivered on the Bus Bar—$50 for 24 hours service.

Steam Power delivered at engine—$35 for 24 hours service.

60 Cycle Water Power delivered on the Bus Bar—$15 for 24 hours service.

25 Cycle Water Power delivered at 60 cycles on the B.B.—$25 for 24 hours service.

25 Cycle Water Power delivered at 25 cycles on the B.B.—$15 for 24 hours service.

1st. We have the station costs for small arc dynamos, large arc dynamos, and constant current transformers under different operating conditions.

2nd. The line costs for open and enclosed D. C. and enclosed A. C. lamps.

3rd. The efficiency, power factor, horse-power, and apparent horse-power for the different types of apparatus. Also an assumed cost of power under different conditions.

From this table we should be able without much trouble to determine the approximate annual cost of a 500 arc lamp plant under almost any conditions. For example, let us take a 60 cycle water-power plant with steam reserve, using direct connected sets and enclosed lamps. From the table we find:

The station costs	$ 6,453 00
The line costs	5,292 00
The efficiency of direct connected sets is 81 per cent. and the actual power required 397 h.p., this at an assumed figure of $15 per h.p. for 60 cycle water-power would equal $5,955; but $15 is for 24 hours service, so it might be fairer to charge the arc plant with but one-half of this, or $7.50 per h.p., at which the cost of our power would equal	2,977 50
The total cost would, therefore, be	$14,722 50
Or a cost per arc lamp of about	29 44

Table No. 5.

Summary of Annual Costs.

Station Costs—Interest, Depreciation, Maintenance and Operation.

Style of Station Arc Apparatus in use.	Water Power, 60 Cycles: Motors and Shafting.	Water Power, 60 Cycles: Direct Connected Sets.	Water Power, 60 Cycles: Constant Current Transformers.	Water Power, 25 Cycles: Motors and Shafting.	Water Power, 25 Cycles: Direct Connected Sets.	Water Power, 25 Cycles: Constant Current Transformers.	Steam Power, 60 Cycles: Motors and Shafting.	Steam Power, 60 Cycles: Direct Connected Sets.	Steam Power, 60 Cycles: Constant Current Transformers.	Steam Power, Engine: Engine and Shafting.	Water Power and Steam Reserve, 60 Cycles: Engine and Motors Connected to Shafting.	Water Power and Steam Reserve, 60 Cycles: Motors connected to Shafting.	Water Power and Steam Reserve, 60 Cycles: Direct Connected Sets.	Water Power and Steam Reserve, 60 Cycles: Constant Current Transformers.	Water Power and Steam Reserve, 25 Cycles: Engine and Motors Connected to Shafting.	Water Power and Steam Reserve, 25 Cycles: Motors Connected to Shafting.	Water Power and Steam Reserve, 25 Cycles: Direct Connected Sets.	Water Power and Steam Reserve, 25 Cycles: Constant Current Transformers
	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$
Small Arc Dynamos	7067	....	....	7067	....	....	7067	....	....	7818	9084	7067	....	....	9084	7067	....	....
Large Arc Dynamos	....	6453	....	....	6453	....	....	6543	....	7258	8660	....	6453	....	8660	....	6453	....
Constant Current Transformers	....	....	1415	....	....	1415	....	....	1415	....	....	....	....	1415	....	....	....	1415

Line Costs—Interest, Depreciation, Maintenance and Operation.

Open D.C. Lamps: Total Cost	Open D.C. Lamps: Cost per Lamp	Enclosed D.C. Lamps: Total Cost	Enclosed D.C. Lamps: Cost per Lamp	Enclosed A.C. Lamps: Total Cost	Enclosed A.C. Lamps: Cost per Lamp
$9500	$19	$5292	$10 6	$5842	$11 7

Efficiency and Power Factor.

	Direct Connected Sets	Motors and Shafting: Small Dyn.	Motors and Shafting: Large Dyn.	Engine and Shafting: Small Dyn.	Engine and Shafting: Large Dyn.	Constant Current Transformers
Efficiency	81%	53.8%	76.8%	52.7%	75.25%	93%
Power Factor	.92	92	.92	100	100	.75
H.P. required for 500 Lamps	397	598	420	614	427	347
Approximate H.P required for 500 Lamps	432	650	456	614	427	462

We might now compare this cost with the cost of constant current transformers on 25 cycle water-power. For this system we find from our table that:

The station costs	$ 1,415 00
The line costs	5,842 00
We also find that our efficiency is 93 per cent., and that the actual power required will be about 347 h.p. Our cost for power in this case will not be the same, as A. C. arc lamps will not operate on 25 cycles, so we will have to take the cost of power after it has been changed to 60 cycles; this we find is $25 per h.p.; 347 h.p. × $12.50 (half as in the other example) would be	4,337 50
The total cost for this system being	$11,594 50
Or a cost per arc lamp of	23 02

A saving in cost by the use of the A. C. system of $6.42 per lamp. When the cost of power is known to vary from those assumed in this table the change can readily be made. In most cases the cost of power would likely have to be figured on the basis of apparent horse-power rather than actual horse-power; both are found in the table.

(For discussion of this paper see page 298.)

The Canadian Engineer

VOL. XI.—No. 11. TORONTO AND MONTREAL, NOVEMBER, 1904. PRICE 10 CENTS $1.00 PER YEAR

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE
CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY, MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada, Great Britain and the United States, $1.00 per year, foreign, 6s. Advertising rates on application.

OFFICES—18 Court St. Toronto ; and Fraser Building, Montreal.
Toronto Telephone, Main 4310. Montreal Telephone, Main 2589.
BIGGAR-SAMUEL, LIMITED, Publishers.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 15th of the preceding month or if proof is desired, 4 days earlier.

CONTENTS OF THIS NUMBER.

THE STEAM TURBINE IN MARINE WORK.

For marine service the first acquaintance of Canadian engineers with the steam turbine is in the work of the steamer Turbinia, which has been running between Hamilton and Toronto for a part of the season now closing. She has run daily without accident, and her engineers are highly satisfied with her performances. Her coal consumption has averaged 2.21 tons per hour under a speed of 23 miles per hour, or 1.48 lbs. of coal per indicated horse-power per hour, as compared with 1.58 lbs. with the best average results of the reciprocating triple expansion engine. The Turbinia is a vessel of 1,060 tons gross, and has engines of 3,400 horse-power. Passengers on the Turbinia are sensible of a vibration, but this is a vibration of a different kind from that due to the motion of the crank and piston of a reciprocating engine. It is caused in the case of the Turbinia by the rapid whirl of the propellers. It is not the racking sort of vibration of the old walking beam, or the present day compound engine, but a trembling less damaging to the frame of the boat, and less disturbing to the passengers. It is believed that this quivering can be greatly reduced by a special arrangement of the bearings of the propeller shafts.

Apart from economy of coal when running at high speeds, the chief points in which, in the opinion of the engineers of this boat, the turbine engine is superior to the reciprocating are: the smaller space required for engine and machinery, this leaving more room for cargo, coal, or passenger accommodation; greater simplicity of the parts of the engine and less liability to break-downs; reduction of weight of machinery; reduction in the staff of engineers, and no vibration of the kind to which a reciprocating engine subjects a ship. Two engineers run the Turbinia; but it is stated that the reduction on a larger boat would be greater in proportion to tonnage. An Atlantic liner of the modern type would require seventeen engineers with reciprocating engines against ten or twelve with turbine engines.

These are all important considerations, and the only serious charge against the turbine marine engine is that while it is more economical of coal at a high speed it is of relatively low efficiency at slow speed. This charge could be ignored in the case of a merchant steamer where constant high speed is the rule and quick time the thing aimed at in a long voyage, but in the case of a warship the lazy rate of progress in cruising or feeling for an enemy would be uneconomical with the present style of turbine. But it is practically certain that this defect of the turbine will be overcome in time; and when we recollect that in a hundred year's record of the reciprocating engine coal consumption has been reduced from 12 lbs. of coal per horse-power to say $1\frac{1}{2}$ lbs., we should think it strange if improvements are not made in turbine engine practice in the near future. In fact two or three new types of turbines of recognized merit are now being tested, while combinations of the turbine and reciprocating engine are now being put into some new English boats. Since the turbine engine gets 127 expansions against 27 expansions in the reciprocating, and since there is less efficiency in the early expansions of the former than in the latter, the idea is suggested that the turbine might be used to replace the low pressure cylinder in a compound engine. In this combination, however, the simplicity and compactness of the turbine would be lost along with the more favorable use of super-heated steam, so that this hybridizing is scarcely likely to offer the best line of improvement.

The difficulty of reversing is a minor defect in the turbine. The Canadian Turbinia has three propellers, one a high pressure in the middle of the ship, and two low pressure, one on each side. The latter are reversing, the former non-reversing. The officers say this ship is easily handled when getting in and out of dock. An experiment in a combination of engines to deal better with the problem of reversing

is now being made by the Yarrows, of London, who are building a first-class torpedo boat which has the middle screw driven by a reciprocating engine, and the outside screws by turbines. These turbines are not of the Parsons or Curtis type, more commonly known, but are the invention of Prof. Rateau, of Paris, who in a paper which will be quoted in next issue, states that the combination of reciprocating and turbine engines affords the easiest solution of the problem of marine propulsion.

We may add that the commission of experts recently appointed by the Cunard Company to investigate the performances of two sister ships—the Brighton with turbine engines, and the Arundel with the latest development of reciprocating engines—has reported, and though the report is not published in detail, it is known that these experts report definitely in favor of the turbine principle. A commission of experts from the United States navy also paid a visit to the Turbinia as she was running on Lake Ontario and has announced unofficially that it will endorse the turbine.

THE MODEL OF RAILWAY OPERATION.

The railways of Canada have before them two models upon which they may base their system of operation—the British and the United States. So far as the construction of rolling stock is concerned, the climate of the country, the relatively great distances between stations, and the habits of the people all point to an approximation to the United States system as the most suitable for Canada. But because the style of locomotives and freight and passenger cars approximate more nearly to the system of the United States, there is no reason why all the evils of the United States system of operating railways should be adopted as the model for Canada. If all the railways of Canada were owned by the state it is probable that before now, public opinion would have compelled the adoption of some at least of the European safe guards, which would make travelling much safer in this country than in the United States. A direct responsibility to the public, and a common ownership throughout all the provinces would render such reforms easier of accomplishment because each step in the reform could be applied at once to the whole country, and would have the sympathy of the people in carrying it out.

But whether our railways are owned by private companies or the state, there is no reason why Canada should deliberately select as its model the worst operated railway system in the civilized world—that of the United States. If Canadian railways could be either persuaded or compelled to adopt the more essential of the safe guards in use on the railways of the British Isles and in some European states the result in the lessened casualty list would be one of the best advertisements the country could have in the eyes of the world, and especially in the eyes of our American neighbors. The present loss of revenue caused by the increased expenses of these reforms would be more than made up by ultimate increase of traffic and enhanced reputation.

It is not an unusual thing for a British railway company to get through a whole year without losing the life of a single passenger, and in the year 1901, every railway in Great Britain and Ireland was free of a death list, though 476 received injuries in minor accidents. Compare this with the woeful record of railway operation in the United States. The bulletins prepared by the Interstate Commerce Commission show that last year in the States 9,984 people were killed and 78,247 injured in railway accidents. What an appalling disregard of human life! According to the press report an officer of the commission stated that the "increase of fatalities annually is regular, growing with the extension of the railroads and population. We have received reports from England which are as remarkable as the killings here. Approximately, the English average less than 50,000 miles of track to our 200,000, yet they do greater per mile business than we do. They haul more passengers than we do, yet there was not one passenger killed in a recent year." The records of the commission show that in the last ten years 78,152 persons have lost their lives in railroad accidents. These deaths are distributed yearly as follows:—1895, 6,136; 1896, 5,845; 1897, 6,437; 1898, 6,859; 1899, 7,123; 1900, 7,865; 1901, 8,455; 1902, 8,588; 1903, 9,840; 1904, 9,984.

We gave in last issue some statistics of accidents to Canadian railways. The causes of this heavy death and accident list on railways in this country and the United States are various. Lack of efficient signaling systems, the want of a safe train order system, and the long hours of train hands and station hands are among the most fruitful causes of disaster. As regards the last named cause some managers shelter themselves behind the fact that train hands and others, in order to earn extra pay, contravene the company's rules which usually limit the hours of duty. Since no plea of this sort coming from an employee would be tolerated by the companies themselves in the case of breach of the rules against intoxication, it is equally flimsy as a plea from a railway manager to the public when an accident is caused by the drowsiness of a train-hand or station-hand exhausted by long hours on duty.

Although it is a question whether the heavy loss of railway property (apart from the awful loss of human lives), and the many damages that have to be paid for personal injuries would not cover the extra cost of operating large roads on the British system, yet the idea of economy is at the root of the present reckless system of operation on this continent. A railway expert in Chicago said the other day: "The life of a railroad manager is short—in that office, I mean—and his only care is to make a good showing in earnings. That is one reason for the American system of operating railroads." While doubtless unjust to many railway managers personally, this is too true of boards of directors and is true of the American system as a system.

"A great deal has been said about the immunity from accidents on the English and continental railroads," says another critic of United States roads, "and the fact that the block system is universally used there is given as the cause. This system tends to prevent accidents, but we must go farther to find safety in this country. Many hundreds of miles are

protected by fixed signals here, but I know of four accidents which happened within the limits of fixed signals on one railroad in this country. Yet it is supposed the signals were working perfectly. Foreign railroad managers operate their roads entirely differently so far as the rules for moving trains are concerned. There trains cannot move without signals; here they cannot move without train orders, which are never used in Europe. Here the signal is only auxiliary. It will be absolutely necessary to revise our rules for the movement of trains before we can expect to get any benefit whatever from any possible combinations of signals, except the automatic stopping device, and the sooner the people are made aware of the fact the sooner will this reform take place."

The Scientific American in a recent article on this subject under the appropriate heading, "How much, then, is a man better than a sheep?" makes a comparison of the death lists of the two countries, and says:—"We have to confess that, so far from there being any mitigating circumstances, the more we look into the question the more inexcusable does our own shocking death list appear; and for the following reasons: First, the total number of passengers carried is greater in Great Britain; second, this greater number is handled upon one-eighth as many miles of track—24,000 miles in Great Britain as against 200,000 miles in the United States; and, thirdly, the average speed and the frequency of the trains is greater there. So that the slaughter that is going on is actually less excusable than the mere figures—and Heaven knows they are bad enough—would show. For with a smaller total number of passengers and trains, and in spite of the fact that they are spread over eight times as many miles of track, we kill 77 in 15 days while they kill one in 15 months. But why this appalling difference; and what, if any, shall be the remedy? Perhaps the trouble is that we have not as yet arrived at a proper estimate as to by how much a man is better than a sheep." The writer then goes on to show how the habitual disobedience of orders by engineers who are too ready "to take chances" in running past signals, could be effectually dealt with if the companies made the saving of life their purpose.

ELECTRIC SMELTING.

P. Heroult, of La Praz, France, discoverer of the electric process of manufacturing aluminum, and inventor of an electrolytic process of steel making, recently visited Canada, and is reported to be interesting himself in the development of his process in iron and steel making in this country. He recognizes the advantages Canada possesses in having great powers within transmissible distance of iron and other mineral deposits, and we may look for an electric smelting plant on a commercial scale at an early date. Dr. Haanel, of the mines department of the Geological Survey, with whom Mr. Heroult had a conference, is reported as making the following statement on the subject: The application of electricity to the smelting of ores promises important results for Canada. So far as magnetic iron ore is concerned, there is little doubt of the superiority of the electric over the blast furnace. For the treatment of refractory ores, which abound in Canada, the blast furnace does not yield sufficient heat, probably not more than 2,000 degrees. By means of electricity 3,000 and more degrees of heat are developed. Electricity is also indispensable for the extraction of titanium and phosphorus and sulphur from the ores. Furthermore, the electric current can be regulated to a nicety and kept under control. Wherever water power exists electricity can be economically generated, and costs less in the smelting of ores than fuel. Steel can be produced by the electric process for $12 a ton, and perhaps less. At this rate it can easily undersell steel from the blast furnace.

An estimate, for instance, has been made that the cost of electricity from the Chats Rapids on the Ottawa River would be only $4.50 per horse-power per annum. Within easy access are the Bristol iron mines. There are, of course, many other situations equally favorable for the electric reduction of ores in different provinces, and Canada ought to lead the world in the new metallurgy.

—In our Sept. issue it was mentioned that the St. Clair Tunnel Co., which operates the Sarnia tunnel for the Grand Trunk Railway, were investigating the question of introducing electric locomotives for hauling trains through the tunnel. The necessity for such an investigation was demonstrated in a tragic way before October was half out, for on Sunday, the 9th ult., a freight train parted while being taken through, and in the endeavor to clear the tracks six men perished from the fumes of coal gas. The night was foggy, and the heavy air gave no draught through the tunnel, and but for the heroism of one of the rescue party more lives would have been lost. The lowest part of the tunnel being under the river, the problem of ventilation is a difficult one. Carbonic acid gas (carbon dioxide) settles always in the lowest parts of a confined space, such as a mine or tunnel, and where, as in this case, direct overhead ventilation cannot be obtained, the use of coal burning locomotives will always present grave dangers to passengers and railway employees. For years past the special suitability of the electric locomotive for just such situations as this has been demonstrated on three or four continents and if the St. Clair Tunnel Company had been as anxious to save lives as to earn dividends it could have settled this question long ago without any expensive enquiries. The coroner's jury never called any witness to demonstrate that other means of haulage could have been adopted, and its verdict that if the company had "had better equipment for ventilation it would, in a measure, have prevented the accidents that have occurred since the opening of the tunnel for traffic," is rather a lame conclusion to so important an enquiry. If electricity were used there would be practically no need for ventilation, as there would be no carbonic acid gas generated. The Railway Commission has called the company's attention to the necessity for a change in the method of operating trains and has sent its experts, Messrs. Mountain and Duval to report. These gentlemen will

have no difficulty in getting the most satisfactory evidence that the electric locomotive will provide a perfectly feasible and safe system for performing all work at this tunnel.

—We print elsewhere the opinion of a New York financial paper on the commercial aspect of the various Niagara Falls electric development works. The Canadian Engineer does not share the pessimistic views of that paper. One of the companies on the Canadian side of the Niagara is financially identical with the power company which installed the first large works on the United States side, and has undertaken its Canadian works with its eyes open, and after several years' experience as a pioneer in the development of large units for transmission to Buffalo and other towns as well as for consumption around Niagara Falls. The other two Canadian power companies are undertaken by men who not only understand the electrical business, but are skilled financiers, and know pretty thoroughly the commercial prospects of what they have undertaken. It is true that the 375,000-h.p. in course of development on the Canadian side is in excess of the visible present requirements in the Niagara peninsula and Toronto, but electric power can be transmitted to Ontario points as far west as London, and the local chemical and industrial works of the Canadian side of the Falls are certain of creation when the power is ready. In fact the electro-chemical industries of the Canadian side of the Niagara will be one of the wonders of the Falls second only to the scenic wonders, and these can and will be the direct creation of electric power. Some of these electro-chemical industries afford enough profit to enable a power company owning them to supply the electric energy for nothing. At all events, the men at the head of the electric developments at Niagara are not taking any anxious thought about the future of their enterprises. In the meantime they have no difficulty in finding all the money needed for accomplishing what they have undertaken.

TELEPHONE AND TELEGRAPH.

The International Telephone Co. is laying a telephone cable fifteen miles long, connecting Vancouver, Victoria, Marietta, Wash., and several intermediate points.

The Bell Telephone Co., which is extending its long distance equipment steadily in Manitoba, intends to connect with the American Bell system at Pembina and St. Vincent.

Stephen D. Field, nephew of the Atlantic cable inventor, has invented an amplifier which may be applied to a wireless receiving instrument, so as to make possible the recording of a telegraphic message. The amplifier can also be attached to ocean cables and greatly increase the speed of transmission.

On October 19th, a deputation of Brantford aldermen visited Toronto Junction and inspected the "Stark" telephone, light, and power system in operation there. As a result, a recommendation will be made that the company's offer for a franchise in Brantford be accepted. The deputation were enthusiastic in their praise of the system.

H. E. Brockwell, superintendent of service for the Bell Telephone Company, and J. McMillan, of the Canadian Pacific Telegraph, are superintending the installation of the composite telephone in Manitoba. The new system is so designed that telephone and telegraph messages can be transmitted over the same wire simultaneously.—Winnipeg Free Press.

William Marconi has been on this side of the water recently. His plans in brief are as follows: The Glace Bay station is to be moved to a more protected site inland, and the power of the transmitter greatly increased. The Poldhu, Eng., station will then be similarly increased in power, and by the new year Mr. Marconi hopes to have commercial connection across the Atlantic.

—E. L. Chadwick, representing W. H. C. Mussen & Co, Montreal, was in Toronto about the end of last month.

—St. John, N.B., has decided to purchase the electric light plant, in Carleton, a suburb of the city.

—The new tug Togo, built for G. S. Campbell & Co., Halifax, N.S., for harbor towing work, was given her trial trip Oct. 20th. The Togo is fitted for use as a fire and wrecking tug.

—The steamer Kenosha of the Kawartha Lakes Navigation Co.'s fleet was burned to the water's edge at Lindsay, October 22nd. The boat was valued at $7,500, and was insured for $4,000.

—The New Brunswick Southern Railway is making improvements in its roadbed, and is adding to its rolling stock, and hopes within a few months to have a through fast express from St. John to Boston.

—A rich nickel-copper deposit was discovered recently on the Montreal river in the Temagami reserve. Asbestus and mica have also been located on the reserve, of which the Crown Lands Department expects detailed reports later.

—The Temiskaming and Northern Ontario Railway is now running three trains each way per week from North Bay to New Liskeard. It is expected that the rails will be laid some thirty miles beyond New Liskeard before the end of the year.

—The contract for the air-brake equipment of the Grand Trunk Pacific has been awarded to the Canadian Westinghouse Air Brake Co., of Hamilton. It is said that the contract will take half of the output of the factory for the next four years.

—The Peterborough Shovel and Tool Co. was recently incorporated by Thos. Fortye, A. L. Sykes, A. Elliott and others of Peterborough, with a capital of $50,000. A building will be put up immediately, and the factory will be in operation as soon as possible.

—The Dominion Department of Marine has placed thirteen gas buoys at important points on the ship channel of the St. Lawrence between Grondines and Ile Bigot. They are steel spar buoys showing acetylene gas lights 13 ft. above high water mark.

—We regret that, through an oversight, the valuable article on Insulation, which commenced in our last issue, and which is concluded on page 351 of this number, was not credited in the initial instalment to our esteemed contemporary, The Electrical Engineer, of London.

FIRST TURBINE ATLANTIC LINER.

There has been launched from the shipbuilding yard of Workman, Clark & Co., Belfast, the steamer Victorian, the first of the two turbine-driven ships ordered by the Allan Line.

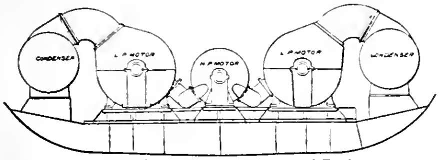
The Victorian is the pioneer turbine vessel for the Atlantic or any other ocean service, and, as such, her launch is an event of more than ordinary interest. She and the Virginian, now being built on the Clyde, are sister ships as regards dimensions, capacity and power. This pair of twelve thousand tonners will form a notable reinforcement to the fine fleet of the Allan Line, which already numbers twenty-eight steamers, and comprises several vessels of ten thousand tons each engaged in the mail passenger, and general service between the United Kingdom and Canada. Splendid ships, however, as are the Bavarian, Tunisian, Parisian, and Ionian, the Victorian exceeds them in size by 2,000 tons, and, as regards speed, is expected to be a long way in advance of them.

That she is one of the handsomest vessels ever built in Belfast was the opinion of every expert who saw her on the stocks before the launch or in the water afterwards. She is a striking contrast to the ordinary straight-sided ocean steamer of to-day. Her lines fore and aft are sharp and clean, swelling gracefully into a noble breadth amidships, which suggests

high qualities of steadiness and stability, as well as a capacity for speed, which could hardly be excelled. Before she took the water people viewed with interest her three propellers—a novel feature in an Atlantic liner.

For a considerable time it has been debated whether the turbine would be practicable as a means of propelling the giant ships that carry our cross-Atlantic passenger traffic, and while other great shipping companies were looking for more light and hesitating to plunge into a practical experiment that might involve heavy loss, the Allan Company boldly assumed the responsibility of giving the lead. They lost no time either. Twelve months ago the keel of the Victorian was laid by Workman, Clark & Co. Now she has been successfully launched, and before the end of the year it is expected she will be ready for sea. Her trial trip will of course be the crucial test, and upon it much will depend. For it may be taken for granted that other important companies which have decided to adopt turbine engines for new liners will watch with attention the earliest performances of the Victorian.

Originally, the Victorian was designed to be driven by reciprocating engines, but after some progress had been made with her hull, Messrs. Allan decided that she should have turbines instead. Workman, Clark & Co. made the necessary alterations in her structural design, and at the same time undertook what was a far more difficult and delicate task, the construction of the great turbines—the largest ever made—which are to drive her. This was by arrangement with Parsons & Co., for it was the Parsons turbine that was decided upon. A high-pressure and two low-pressure turbines will drive the three propellers of the ship, which, by the way, strike one as being unusually small to drive a monster possessing a cargo capacity of more than 8,000 tons, besides accommodation and equipment for upwards of 1,300 passengers. These propellers, however, revolve at very high speed—from 270 to 300 revolutions per minute. The central one, arranged as in



Cross Section Showing Arrangement of Turbines

a single-screw vessel, is worked by the high-pressure turbine, the others, which are arranged as in a twin-screw ship, by the low-pressure turbines. The two latter have each a reversing arrangement which enables them to be driven full speed astern, either together or independently. Thus the ship will be as easily and effectively manœuvred as regards turning or backing as an ordinary twin-screw. This disposes of the objection which has sometimes been urged against turbines, that they are defective with regard. to reversing motion.

The principle of the steam turbine is less generally understood than that of ordinary reciprocating engines. Briefly, a turbine engine is a fixed cylinder upon the inside surface of which are mounted rings of brass blades projecting radially inwards. Inside this revolves a drum armed on its outer surface with similar rings of blades set at an angle to the fixed blades, and arranged so that they are "sandwiched," so to speak, between those of the fixed cylinder. Steam is admitted at one end of the turbine, and passes through longitudinally in a zig-zag path, being deflected from the fixed rows of blades in the turbine casing against the rows of blades on the drum, causing the latter, which is built on the propeller shafting, to revolve, and thus drive the propeller. The "fixed blades" (those in the cylinder), act as guides to deliver the steam with proper direction and velocity against the "moving blades" (those on the drum). Thus the full power of the steam is utilized, and in a direct and continuous way.

The term "blades," when used in connection with the machinery of an ocean liner seems to suggest a screw propeller or something equally formidable. But these turbine blades are surprisingly small—no larger than a lady's little finger. Their number, however, is prodigious, there being no less than a million and a half separate pieces used in the blading of the three turbines of the Victorian.

It may be easily imagined, when the principle of the steam turbine is grasped, that everything depends upon the proper "set" and inclination of the two sets of blades. Hence the difficult and delicate character of the constructive work. The manufacture of the turbines is well forward. Workman, Clark & Co. have a special engine shop, equipped with the necessary plant devoted to them, and C. E. Allan, one of the members of the firm, personally superintends their construction. It will, however, require some weeks longer of skilful and arduous labor before the turbines are ready to be fitted in the Victorian.

The energy of the steam is used up to the last ounce in its passage through the turbine. But economy of power and room are not the only advantages which the turbine promises in connection with ocean traffic. There is a complete absence of the unbalanced forces which cause vibration in an ordinary steamer, and which is thus reduced to vanishing point. Then there is very little fear of breakdown, because there are no moving parts to break or get out of order. It is usually the breaking of a crank shaft, or connecting rod, or some such appliances that cause trouble on a modern steamer. Here the steam acts directly, driving the shafts of the ship with an even turning movement, enormously reducing the stresses to which the moving parts of ordinary engines are subjected. Indeed, it is claimed for the turbine that there is a saving in weight, space, attendance, up-keep, to say nothing of a considerable increase in speed.

Owing to this economy of space the builders have been able to provide accommodation on board the Victorian, such as is probably not to be equalled by any vessel of her size afloat. They have utilized the saving not to increase the number of passengers carried, but to give every possible comfort and luxury to all three classes of passengers. The Victorian will be emphatically a comfortable ship so far as the perfection of appointment can make her so. Care for the humble steerage passenger has always been a leading point of policy with the Allan Line; in the Victorian it is exemplified in a remarkable degree. Even in their unfinished condition, the music-room, dining-room, and other special accommodation for this class challenge admiration for their roominess and completeness of equipment.

The steam to drive the turbines will be generated by eight large boilers.

The length of the Victorian is 540 feet; her breadth, 60 feet; her depth 40 feet 6 inches. She is divided by bulkheads into eleven compartments, and with the sub-divisions of her double-bottom she has twenty watertight spaces. She is built to the highest class of the British Corporation Registry of Shipping, and her hull has been specially strengthened above the requirements of the Corporation in order to make her doubly secure against the heavy weather of the North Atlantic. The first-class accommodation, which, as usual, is amidships, is of the most complete and approved order. Perfectly heated and ventilated staterooms, and suites of rooms, a spacious and well-fitted dining-saloon, an elegantly appointed music-room, and a luxuriously equipped smokeroom are some of the features. Not less comfortable proportionately are the second-class quarters, and, as already indicated, third-class passengers are catered for in the most liberal manner. Electric light throughout, a complete printing outfit, and an installation of Marconi's wireless telegraphy are among the arrangements for the comfort and convenience of passengers.

As regards facilities for the handling of cargo, the ship is as perfectly fitted as possible. She has ten steam winches and derricks for working the holds, and she is provided with insulating chambers and refrigerating plant so as to enable her to carry fruit, dairy produce, etc., from Canada.

The Victorian will take her place on the Allan Canadian mail and passenger service from Liverpool, to be followed by her sister steamer Virginian, now building on the Clyde.

These steamers, with the Bavarian and Tunisian, will land to land provide a service which by reason of the shorter mileage of the route, will compare in length of voyage favorably with the swiftest of the other Atlantic mail services, and as much of the voyage is in land-encompassed seas, the Canadian route cannot fail to become increasingly popular with that great section of ocean travellers to whom a short and smooth sea voyage is an attraction.

FAIRBANKS SCALE AT POINT EDWARD.

Editor Canadian Engineer,—

Sir,—We were greatly astonished at reading an item in your last issue relating to our scales. This item is doubtless copied from another paper. We may say that these scales were sold to the elevator people and that the engineer and the elevator people admit defective material was used in the installation of one of these scales. This timber broke and the entire weight of the hopper came upon the levers of the scale, which, naturally, broke them.

"Fairbanks" Hopper Scales have a reputation extending throughout the Dominion, and every important elevator has them installed with possibly one or two exceptions. There is in all the great elevators at Port Arthur and Fort William nothing but Fairbanks Hopper Scales, and in elevators being erected at these points this season Fairbanks scales have been exclusively used. The elevators at Depot Harbor and at Coteau Landing (Canada Atlantic Railway), are equipped with Fairbanks scales, as well as those of the Canadian Pacific and Grand Trunk Railways. The Canadian Government elevators at Montreal are also equipped with Fairbanks scales.

This is the first instance in which any trouble has been caused, and both the engineer and elevator people admit it was not the fault of the scale but was the fault of the mechanic who installed the scale permitting inferior timber to be used, which was furnished not by the Fairbanks Co., but by the parties owning the elevator.

Yours truly,

THE FAIRBANKS CO.

Montreal, October 7th, 1904.

Walker House, Toronto, Oct. 25th, 1904.

Messrs. The Fairbanks Co., Montreal, Que.

Gentlemen,—Your letter of recent date, enclosing clipping from Canadian Engineer regarding scale at Point Edward Elevator, is received.

In reply would say that the whole statement as printed is largely misrepresentation, and is evidently inspired by your Canadian competitors for the sole purpose of injuring the Fairbanks scale.

The accident to the scale at Point Edward, was due entirely to the use of a defective timber in supporting the scale, and was in nowise attributable to the scale itself. The timber was sound and looked well, and had passed the elevator company's inspector; and was supposed to be all right. It was, however, of soft white pine, and although the scale had been in use for several months, the timber gave way and allowed the scale to fall to the next floor. The scale, of course, was partly wrecked, and other damage done. The statement, however, that difficulty arose as to who should stand the loss is utterly false and malicious. When the accident occurred, I at once recognized the moral obligation on my part, not to allow the loss to entirely fall upon the Elevator Company alone, I therefore requested that your company replace the broken parts of the scale, and to again supervise the erection of same, all of which you did free of cost either to the elevator company or to myself, and all of which was done without any objection on your part.

To cover the balance of the loss, I gave the elevator company a check in amount sufficient to let them out of this accident about, if not fully even.

Yours very truly,

J. H. TROMANHAUSER.

Architect and Builder Grain Elevators, Minneapolis.

[Note.—The foregoing letters refer to a paragraph in last issue, which stated or implied that the accident was due to some fault of the scale. It is clear from these letters that the accident was entirely the fault of the defective timber in the building, as acknowledged frankly by the contractor himself. We very much regret the injustice done The Fairbanks Co. by the publication of this paragraph, which did not originate with this journal, but was quoted from a Hamilton paper.]

INDUSTRIAL NOTES.

The American Horse Shoe Co. is erecting a plant in Hamilton.

Schultz Bros., of Brantford, have been given an $18,000 contract for a new rink in that city.

The Dowsley Spring and Axle Co., of Chatham, Ont., will put in a new engine and increase their power.

The Henderson Roller Bearing Co., of Canada, Limited, head office and factory at Toronto, proposes to erect a factory in Winnipeg.

It is stated that the John B. McCutcheon Co., machinists, of Battle Creek, Michigan, may open a machine shop at Yorkton, N.W.T.

The International Association of Steam Engineers of the United States will hold its next annual convention in Toronto, in September, 1905.

An English company is now bringing out machinery to equip a salt works at Winnipegosis, Man., on property belonging to Paul Woods, of Sifton, Man.

The Mount McKay Brick and Tile Company, of Fort William, Ont., have installed a complete plant, capable of producing upwards of 3,000,000 brick in the season.

The Dominion Government is to build a wagon road from Edmonton to Peace River Landing, a distance of 480 miles. Work will commence in December.

The business of the Kemp Manure Spreader Co., of Stratford, Ont., has been bought up by the Massey-Harris Co. It will still be operated in Stratford.

J. E. Webb, contractor, of Toronto, has started clearing away the ruins of the old Clifton House at Niagara Falls. Plans for the new Clifton are said to be complete.

The Carney Lumber Co. has arranged terms with the town council of Owen Sound for the erection of a lumber mill employing 200 hands, and having a capacity of twenty million feet.

J. A. Ervin, of J. A. Ervin & Co., lumber dealers, Sydney, N.S., writes that he has discovered a peat bog, and wishes to dispose of the property to a firm manufacturing peat.

The Diamond Park Mineral Water Co. will probably erect a large new bottling works in Arnprior next spring, and are asking the town for a nominal assessment for a period of ten years.

The ratepayers of Hespeler have passed a by-law to loan Clark & Demill, of Galt, manufacturers of woodworking machinery, $20,000 to move and establish their plant there. The company will proceed immediately to erect suitable buildings.

The Metal Shingle & Siding Co., of Preston, who were burned out in July, suffered again by fire last month, when their temporary premises were destroyed at a loss of about $30,000. The town has made a loan of $15,000 to the company to enable them to resume business.

Work on the foundation of the new C.P.R. hotel at Victoria, B.C., is being pushed and should be finished by the end of the year. Tenders for the construction of the building—which is to be a seven-story structure of brick and stone—will be received by the divisional engineer at Vancouver up till December 29th.

There has been considerable activity in Renfrew County in connection with the opening of the corundum mines by the Corundum Refiners, Limited. A new post-office has been established near Palmer Rapids, known as Jewellville. Contracts have been let for the construction of thirty dwellings in the new village.

The Canada Car Co., the incorporation of which was noted last month, announces that a large plant, comprising the best features of the plant of the Pressed Steel Car Co., will be erected at once near Montreal, and will be in operation next summer. It will have a capacity of twenty-five wooden cars, fifteen steel cars, and fifteen passenger coaches a day. Besides this the works will have a capacity for steel underframes for twenty-five cars a day and thirty or forty steel truck frames.

A Chicago furniture company will establish a branch factory in Winnipeg, employing 150 hands.

Lewis Bros. & Co., wholesale hardware dealers, of Montreal, have secured a site in Winnipeg on which to erect a large branch warehouse.

After another short term of operation the Belleville rolling mills again closed down on the 11th ult. The city made a seizure for taxes which the company resisted.

The coke blast furnace at Sault Ste. Marie, Ont., one of the two furnaces built to supply pig-iron for the steel plant was started up on the 18th ult., and the charcoal furnace is getting ready for operations.

The John Bowman Hardware Co., of London, Ont., assigned last month with liabilities of $112,901, and assets of $96,234. Montreal, Toronto, New York, and other United States firms are the principal creditors.

The Crowe & Nicholls chair factory, in Stratford, is just about completed. It is the first building in that city constructed of cement. The Stratford Mill Building Co installed the boiler and engine.

Certain shareholders of the Cramp Steel Company have brought a claim for $300,000 against the officers and directors. Plaintiffs call for the cancellation of three hundred thousand dollars' worth of shares on which the directors voted for transfer, also for an injunction to prevent the transfer of assets to the Northern Iron and Steel Company.

Prof. Prince, Commissioner of Fisheries, has visited the fish reduction works at Boston, Portland, and other Atlantic coast ports, to get information for the purpose of establishing similar works in Canada, where the manufacture of fish and fish offal costing two or three dollars per ton into products worth $25 or $30 a ton can be carried on. Of three plants to be erected, the site of one has been fixed at Canso, N.S.

The coke oven plant to be erected at Sault Ste. Marie by the Lake Superior Corporation will have a capacity of about four hundred tons daily. Some 350,000 tons of coke will be handled annually and about 300 men will be employed. Construction work will be started in the spring. All the coke will be taken by the Lake Superior Corporation for use in the blast furnaces on the Canadian side of the river.

The Dominion Iron and Steel Co., Sydney, N.S., have closed a contract with a German firm for installing a plant for the manufacture of pig iron from waste iron ore. This process, which was discovered a few years ago by Bruck, Kretsham & Co., Germany, reduces the cost of the production to not over 75 cents a ton. The plant will have a capacity of 75 tons per day, and this will be enlarged should the process do all that is expected.

The Stirling Company, Limited, of New Jersey, have obtained judgment at Osgoode Hall against the Nickel-Copper Company, of Hamilton, for $68,231. The plaintiff company about two years ago advanced $65,000 to the Nickel-Copper Company on options, but the latter company were unable to fulfill their obligations in the deal, hence the suit to recover the money and interest. The Stirling Company will not be able to realize on the judgment for some time, as Mr. McConnell of Ottawa comes in first with a mortgage for about $200,000 on the Nickel-Copper Company's property. Recently the Hoepfner Refining Company, of Hamilton, which is comprised of some members who are officers in the Nickel-Copper Company, seized the latter's property for about $48,000 rent, alleged to be owing to the Hoepfner Company. In this matter a sale has been hanging fire since the seizure, and it is doubtful if the sale will now take place.

—The Pittsburg Meter Co., manufacturers of water meters and gas meters, East Pittsburg, Pa., have been awarded the gold medal by the international jury at the World's Fair, St. Louis. This is the highest award given to any meter company at the Exhibition.

—The Electrical Development Co., of Toronto, has awarded contracts amounting to $120,000 on the sub-station for the Toronto and Niagara Power Co., at Niagara Falls. The concrete and brick work went to Thomas Mumford, Niagara Falls, for $40,000, the steel work to the Canada Foundry Co. for $45,000, and the galvanized iron work to Wheeler & Bain, Toronto, for $3,600.

RAILWAY NOTES.

Much of the machinery has been removed from the C.P.R shops, in Perth, to the Montreal shops, and the Perth shops will be used only for repairs.

The Grand Trunk Railway contemplates extending its shops at Point St. Charles, Montreal, at a cost of $200,000, and employing a couple of hundred more men when they shall have been completed.

G. A. Mountain, engineer of the Government Railway Commission, accompanied by Joseph Hobson, chief engineer of the Grand Trunk, is investigating the recent railway accident at the Sarnia tunnel.

The Egerton Tram Co. has completed an electric line connecting New Glasgow, Trenton, Stellarton, and Westville, N.S., "the city of the four towns." The line was formally opened on October 14th.

Col. John McNaughten, railway promoter and builder, of New York, has under consideration a line of railway from Grand Forks, B.C., up the north fork of the Kettle river for a distance of fifty miles.

The location of the C.P.R. Toronto-Sudbury line has been completed as far as Craighurst. The point nearest Barrie is about six miles out. A line has been obtained shorter and easier than the one passing through that town.

Fire broke out in the boiler room of the T. H. & B. shops in Hamilton on October 4th. The blacksmith, the machine shop, the car repairing shop, and the interlocking switch tower were destroyed, besides some rolling stock. The loss is estimated at about $35,000, fully insured.

The C.P.R. is considering a scheme for reducing the grade over the Selkirk Mountains at Rogers' Pass, by a tunnel three miles long through the mountain, between Glacier station and Bear Creek. It will be a heavy work, but it is thought that the reduction in the cost of haulage would justify the expense.

The Grand Trunk Railway Company has awarded an order for twenty-five engines of the Richmond compound mogul type to the Kingston Locomotive Works. The new engines are for the Grand Trunk Pacific Railroad, and will entail an expenditure at the works of $400,000. The engines will be forwarded within the next eighteen months.

The Victoria, B.C., Terminal Railway Co., from Victoria to Sidney, now controlled by the Great Northern, may be operated as an electric road. A branch from Oliver siding to New Westminster Bridge is now being built. This will give a direct route from Port Guichon to Vancouver through New Westminster. The Sooke water supply is being examined as a source of power.

The Chronicle reports that the contract has been signed by the Quebec and Lake St. John Railway Company with Edmund Conway, for the branch line from St. Gabriel Station, on the Jacques Cartier river, to the township of Gosford. This line will follow the old route of the Gosford wooden railway for a number of miles and will give access to the magnificent hardwood lands of the township of Gosford, which abound in maple and birch. Mr. Conway expects to have three miles of track laid this fall to a point near the Riviere aux Pins.

In response to a circular from the Railway Commission, railways of the Dominion have agreed among themselves to draft a uniform set of rules to govern the operation of trains. All roads will be compelled to introduce block safety systems wherever business is heavy enough to make it necessary. Automatic switching devices will be insisted upon, so that semaphores will first denote danger before a switch is opened. Hand and light signals will be made uniform on all roads, and a rule will be introduced that no train hand shall work more than a specified number of hours each day, whether he wants to or not.

The Canada Foundry Co. turned out its first locomotive last month, and for the present will turn out one new one per week. The new locomotive is of the consolidated type, compound cylinders, high pressure, 23-inch diameter, and low pressure 35-inch diameter; 26-inch stroke, with four coupled driving wheels on each side, each 57 inches in diameter. The combined weight of the engine and tender

without either coal or water is 208,000 pounds. The tender has a capacity of 5,000 imperial gallons, equalling 25 tons of water, and eleven tons of coal. Frederic Nicholls, the general manager, notes the interesting historical fact that this is the first locomotive built in Toronto since early in the fifties, when the old Northern Railway Co. made locomotives of the small dimensions no longer seen on Canadian railways.

The Chicago and Northwestern Railroad has installed at a cost of $30,000, at Lake Shore Junction, near Chicago, an electric switch and derail system to guard against wrecks. Mechanism in the depot, by means of levers and switchboards, controls five switches and five derailing devices, the electricity being generated by a 5 horse-power gasoline engine, which charges a 56-cell storage battery, which supplies a constant current. An approaching train signals its coming when a mile and a half away through an extra raised rail at the side of the track. This rail is pressed down by the wheels of the engine forming a contact which produces a current and sounds a buzzer at the depot, also dropping the name of the division on the switchboard apparatus. When a train has the right-of-way the derailing apparatus is set automatically so as to throw any trains on the other routes from the track in case they approach the junction.

The Transcontinental Railway Commissioners announce that they have eleven parties in the field in district "A," which covers the Province of New Brunswick, and a like number in district "B," which constitutes that portion of Quebec from the New Brunswick boundary line to Clear Lake, with the following engineers in charge: J. E. Sirois, C. A. Bourget, P. C. Talbot, Alphonse Larue, Samuel Lepage, F. Hibbard, Paul Mercier, J. A. Beaudry, R. E. Hunter, B. Bourgeois. In district "C" eight parties are out, four of them up the Gatineau and four up to the head waters of the Ottawa. The engineers in charge are: W. Osborne, E. O'Sullivan, A. B. Haycock, R. A. Hazelwood, D. B. Brown, J. Wilger, J. F. Armour, J. P. Pim. Mr. Hoare, chief engineer of the Quebec bridge, has a party surveying the approaches to the bridge. Two parties are being despatched to the west side of Lake Abitibi. It is stated that all the engineers in charge of these parties are Canadians. Major Hodgins, C.E., has been appointed district engineer for the Winnipeg district, and has been notified to proceed to Winnipeg and organize the staff preparatory to the commencing of the location surveys from that end. Mr. Armstrong, of the Canadian Northern, has been appointed chief engineer of the division between Winnipeg and the Pacific coast. F. W. Morse, third vice-president of the Grand Trunk, is to take up his residence in Winnipeg, and administer the affairs of the G.T.P. in the West. The Winnipeg Free Press states that the terminal facilities in that city will be arranged by the Government Commission. The point of entry has not been decided, and surveys have not been brought nearer than ten miles of Winnipeg, in order to give a choice of location for the depot, etc. This will be settled so that work may begin in the spring.

MUNICIPAL WORKS, ETC.

Prince Albert, N.W.T., will instal a waterworks system.

Amherstburg ratepayers defeated a by-law to raise $6,000 to purchase a new pump for the waterworks.

A by-law will be submitted to the ratepayers of Brantford, Ont., to raise $60,000, for the erection of a new city hall.

Montreal city council has decided not to purchase the gas plant next spring, consequently the company's franchise will continue for five years.

St. John, N.B., will commence work at once on the extension of the waterworks, using Loch Lomond as a source of supply. F. A. Barbour, C.E., of Boston, is the supervising engineer. The work will cost about $170,000.

The city council of Charlottetown, P.E.I., owing to the high prices charged by local companies for power and light, has asked the De Lano-Osborn Engineering Co., Montreal and Toronto, to prepare plans for a municipal electric lighting and power plant.

The Board of Trade of Clinton, Ont., is investigating the advisability of the purchase by the municipality of the electric light plant of the town.

The municipal gas plant at Owen Sound, recently equipped with new appliances, caught fire a few days ago, and was damaged to the extent of $800. Supposed cause: the overheating of lime in an outbuilding.

Waterloo, Ont., has passed a by-law to purchase the local gas company's plant, and carry it on as a municipal undertaking. The cost of the present plant is $11,000, but $9,000 more is voted for extensions.

London, St. Catharines, and Brantford have recently purchased tapping machines by which connections may be made to water mains without cutting off the flow during the operation. The machines are said to give perfect satisfaction.

Willis Chipman, C.E., Toronto, has reported to the Stratford, Ont., council recommending a new waterworks scheme at cost of $100,000, including engines and boilers. The source would be artesian wells. He recommends placing meters on large consumers.

Toronto has decided to buy stock in the Consumers' Gas Co., and to spend $50,000 on a subway at Lansdowne Ave.,and $45,000 for fire stations at Cowan Ave. and Kew Beach. The by-laws were all carried by a vote taken on October 22nd.

Robert Howe, inspector for the Canadian Fire Underwriters' Association, has advised that Winnipeg should immediately construct a high pressure system for fire protection, with a pumping station on the Red River.

Red Deer, Alta., is installing a waterworks system, having given a $2,900 contract to H. Ramsay, of Calgary. The contract includes a basin, 40 feet by 50 feet, in the Red Deer River, the laying of pipes from there to the pumping station and water mains up to the chief business sections of the town. The pipes to be used will be iron bound wood.

F. L. Fellowes, C.E., engineer of Westmount, Que., has reported recommending a municipal lighting plant in combination with a refuse destructor, the whole to cost about $225,000. The electric plant for arc and incandescent lighting was estimated at $118,076. It is estimated that the cost per kilowatt hour for a 14-hour service would be 6 7-10 cents, against 14¼ cents now paid.

The Water, Light and Power Commissioners of Fenelon Falls, Ont., have closed a contract with the Ambursen Hydraulic Construction Company, of Boston, for the construction of a concrete-steel power dam in the Fenelon river for municipal lighting. The dam is 200 feet long and is about 10 feet high. The work was commenced on the 6th of October and will be finished about the 1st of November. E. Bradley, C.E., of Montreal, is the Canadian representative of the Ambursen Hydraulic Construction Co.

S. Chant, ex-Mayor of St. Thomas, Ont., gave the World representative an account of the progress of that city under municipal ownership of the street railway, which was taken over two years ago. Under private management the road gave a very poor service and finally broke down altogether. As a municipal enterprise it gives a steady service, the cars run on time, and the citizens can depend on them. The result of this improvement is to be seen in the increased patronage of the road, which made a better showing last summer than it ever did before. Tickets good any time during the day are sold at a rate of eight for 25 cents. In addition to these, workmen's and children's tickets sell at the rate of ten for 25 cents. The ten for a quarter tickets may be used by anyone during certain specified hours. So successful has been St. Thomas' experiment with its street railway, that it proposes to extend the system to Port Stanley, a distance of seven miles. The city also intends to own and operate the gas and electric light systems. It has been greatly hampered by the Conmee Act, which was passed just as St. Thomas was making ready to instal a competing system. The city was compelled to proceed under the provisions of the Conmee Act, under which the matter is now being arbitrated. The present charge for gas is $1.50 per thousand, but when the plant is owned by the city, the citizens expect to get it at $1.

The fire committee of the Winnipeg city council has recommended an appropriation of $20,000 for the purchase of two steam fire engines.

The natural gas wells at Medicine Hat, N.W.T., were recently examined by Eugene Coste, M.E., who estimates the output of the deep well at 1,100,000 feet per day. He considers the well an excellent one, but advises the council to sink another deep well as a reserve. The council expect the revenue from gas to reach about $45,000 next year.

The Kerr Engine Company, Limited, of Walkerville, Ont., has been awarded the contract for the supply of the waterworks valves for the City of Winnipeg, Man. This company has recently established agencies in the City of Winnipeg, and report a decided increase in the shipments to that city. E. H. Bissett, 339 Main street, is representing them in the waterworks hydrants and valves, and David Philip, 470 Main street, has charge of the sales of the steam lines, brass globes, gates and iron body valves for steam. The same company are supplying the hydrants and valves for the Boulevard St. Paul work, at Montreal, Que.

LIGHT, HEAT, POWER, ETC.

New machinery has been installed in the electric light power-house at Edmonton, Alta.

The Pictou, N.S., electric lighting plant is about completed, and will be put into commission in a few days.

The Carberry Gas Co. has repaired the damage done to its acetylene lighting plant by the explosion in September.

The Brantford Gas Co. has contracted to supply natural gas in Brantford at 85 cents per thousand for all purposes.

Geo. Alexander has been granted exemption from taxes for seven years in consideration of putting in an electric lighting plant at Kaslo.

The Morris Piano factory at Listowel, was struck by lightning recently, and the dynamo was burned out. Little damage was done to the building.

The Canadian Niagara Power Co. expect to let water into their forebay before ice forms this winter. About half of the power house equipment is in place and just about ready for operation.

The Mexican Light and Power Co., which is controlled by Toronto and Montreal capitalists, have secured a contract from the Federal Government of Mexico for the entire lighting of the City of Mexico and suburbs till 1917, also for the lighting of the post offices and Government building in that city.

The Central California Electric Co., which operates three water-power electric plants, is about to instal a new hydro-electric plant of about 25,000-h.p., working under a 2,100 foot head, the highest head in the world. The installation will be located at Alta Station, on the banks of the American river, about sixty miles from Sacramento.

The Central Ontario Power Co., Peterboro, Ont., will deliver some six thousand electric horse-power to the towns of Bowmanville, Port Hope, Cobourg, and Peterboro, from Burleigh Falls, which is owned by the company, and from Buckhorn Falls. Bowmanville manufacturers have assured nearly fifteen thousand dollars revenue, and the company's rates will cut their steam power bills down by from 30 to 50 per cent.

The Huronian Co. has been organized in New York to generate power for the Canadian Copper Co. A 6,000-h.p. installation, later to be increased to 15,000, is to be made at Turbine, Ont., and the power transmitted thirty miles to Copper Cliff. A contract for generators has been awarded to the Crocker-Wheeler Co., Ampere, N.J., which calls for two 2,000 K.W. alternating current generators of Brown-Bouverie type. These machines will be direct connected to 3,500-h.p. water turbines, which have not yet been contracted for. Power will be derived from High Falls, on the Spanish River. Ross & Holgate, of Montreal, are the consulting engineers, and D. T. Trainor, purchasing agent of the International Nickel Co., New York, is placing the contracts.

The Southwestern Traction Co. have completed [illegible] for their new power house, and as soon as the [illegible] tenders will be called for. The structure, [illegible] machinery, will at the outset cost in the ne[illegible] $200,000. It will furnish power for thirty miles [illegible], which means that, with the extension of the line [illegible] stock on the east and Strathroy and Glencoe on [illegible], it will have to be at least doubled in capacity. T[illegible] are under consideration, one at Lambeth, and the other near St. Thomas.

Contractor A. C. Douglass has completed the [illegible] of the Canadian Niagara Power Company on which he has been working for over three years. It is the first part of the works of the company to be completed. The J[illegible] Machine Company has finished the conduit of the Ontario Power Company. It is over a mile long, eighteen feet in diameter, and constructed entirely of steel. The Toronto and Niagara Power Company has awarded the contract for the erection of their transformer house to Thos. Mun[illegible], of Niagara Falls. The contract for the Ontario Power Company's transforming and distributing station was given to Horne & Elmsley, of Toronto.

The Jandus Interchangeable Arc Lamp, sold in Canada by the Packard Electric Company, Limited, of St. Catharines, is commanding much attention. This lamp is of exceptional merit because of its adaptability to many uses. Among the many points of this lamp, the following are some for which convincing claims are made: One lamp interchangeable for all circuits, individually superior burning qualities, long life, quickest trimmed, low expense for carbons and trimming, compact and neat appearance, uniform 12-inch upper carbon trim, handsome ornamental case of colonial design, accessibility of parts for inspection, non-breaking inner globe that is easily cleaned, etc. The Packard Electric Company have recently prepared a special pamphlet describing the Jandus Arc Lamp in detail, which will be sent free upon application.

After three years of litigation in which the action went through four courts, the case of Randall v. Ottawa Electric Co. was decided last month, by Justice Britton, at Osgoode Hall, Toronto. The claim was brought for Thomas E. Randall, by his next friend, and by Randall's wife, to recover damages for injuries sustained by Randall in Sept., 1901. Randall was a linesman in the employ of the defendants, the Ottawa Electric Co. In doing work on a pole he accidently came in contact with a live wire, was thrown to the ground, and so seriously injured that he became insane. The action was brought against the Electric Company and Ahearn & Soper, Limited. At the first trial the action was dismissed as against the electric company, and the jury disagreed as to the other defendants. The case was taken to a Divisional Court, to the Court of Appeal, and to the Supreme Court, with the result that a new trial was ordered as against defendants Ahearn & Soper. That trial took place at Ottawa last September. In answer to questions submitted the jury found that these defendants were guilty of negligence, which was the proximate cause of the injury to Randall, in leaving the tie wires uncovered, and in not having the ends of these tie wires cut off close, and that he could not by the exercise of reasonable care have avoided the injury. Defendants Ahearn and Soper did not own the pole on which they put their wire, and as to which the jury found negligence, nor had they, so far as appeared, the consent of the owners to use it, and the electric company were not shown to have had any express consent or authority to use that pole, but Randall, in the ordinary course of his employment, was sent to this pole to put upon it a transformer, for the purpose of supplying light to the adjacent building. The Judge held that as between Randall and Ahearn and Soper, the former was not a trespasser, but was rightfully upon the pole. Ahearn and Soper must be taken to have known, in using that pole, that other persons would be just as likely to use it. It was in a central place, with large buildings nearby requiring light for illumination and for ordinary lighting. Ahearn and Soper ought so to have fastened the live wire placed by them on the pole as to render it reasonably safe for persons requiring to use it for any proper purpose connected with transmitting the current.

The jury were told that they might apportion the damages between the two plaintiffs. They assessed the damages at $2,500, and apportioned it, $500 to the husband and $2,000 to the wife.

MARINE NEWS.

The Department of Marine and Fisheries is experimenting with asbestus as a material for portable lighthouses.

The dredge Ottomac, of Preston, Ont., was burned to the water line last month at Quebec, where she was working on the breakwater extension.

The Public Works Department has awarded to the Bertram Engine Works Co., a contract for a "snag boat" for clearing the rivers of Manitoba.

Through the refusal of the men at Yarrow's, the London shipbuilding firm, to work overtime at a rate and a quarter of pay, an order for several torpedo boats was lost to England, and will be executed by a firm at Trieste, Austria.

J. J. Roy, C.E., of the Department of Public Works, is investigating the feasibility of relieving the overflow water of the Assiniboine by diverting it into Lake Manitoba by a channel 15 miles long. One purpose is to prevent the flooding of farm lands, and another is to improve navigation.

A new steamship line is to be established between British Columbia and Mexican ports, the principal owners being Andrew Weir & Co., of Scotland. It is planned to make San Diego a calling port. The company will run modern steamers with capacity of 4,500 tons freight, 50 first-class passengers and 300 to 400 steerage, boats to run semi-monthly. The service will begin in January.

The Champlain, the first of the two ice-breaker steamers ordered by the Department of Marine and Fisheries from Messrs. Flemming & Ferguson, of Paisley, Scotland, arrived at Quebec on October 25th. She will run in connection with the Intercolonial Railway at St. Denis, County of Kamouraska, to points on the North Shore. The Champlain is a steel seagoing passenger steamer, length 120 feet, beam 30 feet, depth of hold 17.6 ft., tonnage, register, 225; gross, 522; draft, 11 ft. The second boat, the Montcalm, was recently launched by the same builders, and will soon leave for Canada. The Montcalm is 250 feet in length, and is designed especially to attempt the breaking of the Cap Rouge ice bridge. She will reach Canada not later than December 1st. In summer she will be used as a lighthouse and buoy tender.

The court investigating the collision between the R. and O. Navigation Co.'s steamer Canada and the steamer Cape Breton, near Sorel on June 12th last, has concluded its sittings and has handed out its report. It finds that the Canada was running in contravention of collision regulations, and thus caused the accident. Elie Bouille, the man in charge of the Canada a the time, was fined $50, and the R. and O. Navigation Co. was ordered to pay the remainder of the cost of the investigation. The company was severely censured for the navigation of its vessels between Montreal and Quebec, which is left in the hands of wheelmen, certificated officers being merely figureheads. Further, no person is detailed to keep a lookout at night; the crew are not in uniform, and have no discipline or fire drill. The certificate of Louis St. Louis, the master, was cancelled, and that of Peter Kane, the mate, was suspended for a year.

PERSONAL.

Talbot Strong, of Toronto, has returned to Galt to take an interest in the James Warnock Co., and will be associated with Byard Warnock in its management.

Dr. Hans Goldschmidt, the eminent chemical scientist of Essen Ruhr, Germany, while in Montreal last month as the guest of William Abbott, his representative in Canada, delivered a lecture, illustrated by lantern slides, at McGill University, on the Alumino-thermit process of welding, as well as on its use in metallurgy and its use in the foundry.

Felix Gouin, civil engineer, for several years in the Department of Public Works in Manitoba, under the Dominion Government, died last month at the age of 42.

H. J. Fuller, manager for the Fairbanks Co. in Canada, was in Toronto in reference to matters connected with their new warehouse to be built on the north side of Front St. West.

Stephen A. Ferguson, assistant city engineer of Detroit, died last month, aged 62. He was a native of Canada, having been born at Woodville, Ont. For several years he was on lake surveys, and was a civil engineer on the Wabash Railway.

John S. Fielding, C.E. & M.E., consulting engineer, has moved from the National Trust Building to 15 Toronto Street, in the Toronto Mortgage Company's building, where he will have greater accommodation for his increasing business.

W. G. Ross, managing director of the Montreal Street Railway has been elected president of the Street Railway Accountants' Association of America. The standard set of forms adopted and used by the Association were devised by Mr. Ross.

J. F. Birchard, travelling representative of J. T. Wing & Co., Detroit, Mich., was in Toronto last week and his many friends in the trade will be pleased to learn that he has fully recovered from the attack of typhoid fever in Los Angeles, Cal., in which city he was confined for six weeks.

Eugene Poisson and M. E. Parrot, engineers representing large construction and engineering firms in France, are now visiting Canada to learn something of the machinery and methods employed in this country, and incidentally to see what openings there are for French machinery.

MINING MATTERS.

The output of the Crow's Nest Pass Coal Co. now averages 3,000 tons a day, or a third more than the average of last year.

The Canadian smelting works at Trail have installed a plant for the manufacturing of lead pipes. The new department is very successful.

The coal mine at Joggins, N.S., is producing 200 tons per day. In two months' time, when the workings stopped by the fire are reached, the output will be about 500 tons daily.

A. D. Griffin, who has been surveying for the Ontario Government west of Lake Abitibi, reports indications of an extensive iron deposit in the newly surveyed township of McCaul and Dundonald.

The Kootenay Ore Co. are erecting a zinc separator in connection with their sampler works at Kaslo. The building will be 80 by 100, and will be fitted with the latest magnetic zinc separators. It is expected that the plant will be in operation early in the spring.

The Carter White Lead Company, of Chicago, has made arrangements to etablish a large lead corroding industry in Montreal. The old shops of the Canadian Pacific on Delorimier avenue have been secured as premises for the new works. It is understood that the metal used will be electrolytic lead from the refinery at Trail, B.C.

The Amalgamated McKee Creek Mining Co. and the McKee Consolidated Mining Co., operating at Atlin, B.C., will be consolidated shortly. The shareholders of the two companies are almost identical, and C. M. Hamshaw is president of both. The consolidation will give an authorized capital of $20,000,000. The shareholders are New York capitalists.

The control of the Cape Breton Coal, Iron and Railway Co. has been taken over by an English syndicate, headed by Horace Mayhew and Coates, Sons & Co., London. The new directors are: H. Mayhew, president; T. Lancaster, vice-president, and Wm. Hanson (Hanson Bros., Montreal), treasurer; E. W. Molsley, secretary, and Messrs. Gladstone, Thompson, C. H. Hanson, of London; N. Ferguson and Crowe, of Sydney. Plans are now being prepared in England for extensions, and equipment will be ordered as soon as the plans are completed.

Mr. McKenzie, of Montreal, who has made the recent mineral discoveries west of Lake St. John, has brought in magnificent samples of asbestus in veins of two, three and four inches in thickness, and also samples of copper, gold and magnetic iron. It appears that these deposits exist in very great quantities at the head waters of the Nottoway river, about 190 miles from Roberval, and if appearances are realized, we may look for a repetition of Sudbury and Thetford in the northern part of the province. It is said that J. Obalski, the geologist of the province, confirms the value of these discoveries.—Quebec Chronicle.

Coleman, Alta., where the colliery of the International Coal and Coke Co. is located in the Crow's Nest region, is a mining town only a year old, and already has a population of 850. It is in the valley of the Old Man River, 16 miles east of the summit of the pass. An electric lighting system is being installed in the town. The mines have an output of 500 tons a day, which is to be increased to 1,000 tons by January next, the ultimate capacity of the present plant being 2,000 tons. Over 100 out of the 400 coke ovens to be installed are now in operation. The areas owned by the company are estimated by one mining engineer to contain over 60,000,000 tons of coal.

W. H. Aldridge, manager of the C.P.R. smelter at Trail, reports that 200 tons daily of nut and larger sizes of hard coal are being mined at Banff, and another hundred tons of the smaller sizes. This is marketed west of Virden at present. There are between four and five hundred men working, the majority being employed on construction. It will require another year to complete the work under consideration. Development work is being done on the soft coal seams as well as the hard seams, but it will be some time before shipments of soft will be started. The total investment in plant, buildings, miners' cottages, water-works, etc., may reach $1,000,000. At present the hard coal smaller than buckwheat No. 1 is being wasted, but experiments are in progress for briquetting.

THE WORLD'S LONGEST TRUSS SPAN.

The new bridge over the Whitewater River at Elizabethtown, Ohio, is the longest single span truss in existence. It is now under construction in the shops of The Brackett Bridge Co., of which H. G. Tyrrell, a native of Canada, is chief engineer. It will require upwards of a year to have it completed and open for travel. The span is 586 feet

H. G. Tyrrell, C.E.

centre to centre of end pins, and the clear distance between trusses is 30 feet. A new feature has been introduced, in the design of the trusses, which gives at the same time an economical arrangement of truss members, and the minimum cost of floor system. The rebuilding of the piers in reinforced concrete is now under way, and it is expected to have them completed before the spring floods.

Mr. Tyrrell is the compiler of the following formulae for the weight of bridges.

Railroad Bridges.

All weights are per lineal foot of single track bridge. Steel only.

Live loads, two engines, 100 tons each, and 4,000 lbs. per lineal foot of track, units 10,000 lbs. and 12,000 lbs. per square inch.

Deck-plate girder bridge	$100 + 9\ l$
Deck-lattice girder bridge	$100 + 8\ l$
Half through plate girder bridge	$300 + 12\ l$
Half through plate girder bridge, ties on shelf angle	$200 + 8\frac{1}{2}\ l$
Half through plate girder bridge with solid steel floor	$600 + 10\ l$
Riveted through truss bridge	$400 + 6\ l$
Riveted deck truss bridge, ties on top chord	$200 + 7\ l$
Through pin bridge	$400 + 5\frac{1}{2}\ l$
Deck pin bridge with stringers	$400 + 6\ l$
Deck pin bridge, ties of top chord	$300 + 6\ l$

Railroad Trestles.

Loads as above.

Weight of spans as above.

Weight of bents and bracing = 9 lbs. per square foot of side profile from ground to base of rail.

Electric Railroad Bridges.

To carry 25-ton cars, or 2,000 lbs. per lineal foot of track, units 10,000 lbs. and 12,000 lbs. per square inch.

Weight of steel per lineal foot of single track bridge are for	l
Beam bridges	$50 + 5\ l$
Deck-plate girder bridges	$50 + 4\frac{1}{2}\ l$
Pony truss bridges	$250 + 1.5\ l$
Through truss bridges	$250 + 1.3\ l$

Electric Railroad Trestles.

Weight of spans as above.

Weight of bents and bracing = 6 lbs. per square foot on side profile from ground to base of rail.

Highway Bridges, with Wood Floors.

Dead weight of floor = 40 lbs. per square foot. Live loads, 100 lbs. per square foot, and units 10.000 lbs. and 12,000 lbs. per square inch.

Weights are per square foot of floor, and include steel only, without joists.

Girder bridge with sidewalks	$3 + \frac{l}{4.4}$
Girder bridge without sidewalks	$3 + \frac{l}{3.4}$
Truss bridge with sidewalks	$3 + \frac{l}{8}$
Truss bridge without sidewalks	$5 + \frac{l}{7}$

Highway Bridges with Solid Floors.

Dead weight of floor = 150 lbs per sq. foot.

Deck-plate girder bridges	$3 + \frac{l}{2.6}$
Half through bridges	$3 + \frac{l}{2.4}$
Truss bridge	$3 + \frac{l}{4}$

In the above l represents the length of span in feet, centre to centre of bearings.

NEW METHOD OF MANUFACTURING STEEL.

It is reported that successful experiments have just been made by the Iron, Steel and Metals Manufacturing Company, at Melbourne, Victoria, for the purpose of proving the value of certain patent rights for the direct production of wrought iron and steel without first producing pig iron. Only a rough idea of the process may at present be had, though trial runs with New Zealand magnetic iron sand are now being made on a somewhat larger scale than hitherto. The sand is first separated from its gangue by electro-magnetic separators, this treatment leaving a pure magnetic iron oxide. The sand is then fed from a bin into the furnace, which is entirely novel in its features, being chiefly mechanical and automatic in its operation.

The ore drops from the bin into a slowly revolving cylinder placed at such an angle that the ore travels forward continuously in it. As it does so it is heated to a dull red by the waste gases from subsequent operations. From this cylinder the ore drops into a second revolving cylinder, where the fine particles are subjected to the action of reducing gases which reduce the magnetic oxide of iron to the metallic form, at the same time permitting the particles to retain their individuality. From this second cylinder the reduced ore drops into a smelting bath at the bottom of the revolving cylinders, and the molten steel or malleable iron, as the case may be, is tapped from this whenever that operation is necessary. It will thus be realized that the process is one of great simplicity and yet of much ingenuity. Not the least interesting part of it is the use of fuel oil for heating purposes. This is employed to secure concentration of heat and direct application in the furnace work. It is found that the fuel oil possesses many advantages over producer gas as used in existing smelting practice. The work done so far has demonstrated that not only is oil a cheap fuel, quite irrespective of the capital outlay that would be required if it was decided to utilize producer gas, but it is so thoroughly under control as to insure the best service.

The temperature at which iron ore melts is given variously at from 1,500 deg. to 2,000 deg. C., according to its purity.

The accurate gauging of temperature in the furnaces plays a very important part in the company's work, and accordingly an installation of thermo-electric thermometers has been made at the company's works. The apparatus consists of a "couple" consisting of a platinum-iridium junction enclosed in a metal tube fully three feet long, which is placed in the centre of the furnace, and the temperature is then recorded on the dial of a special form of voltmeter, each division on which represents 25 deg. C. This voltmeter reads up to 1,600 deg., and is placed at any convenient distance from the furnaces. The various thermometers are connected with a switchboard, which is again connected with the "couples" or tubes in the furnace. In the installation under notice four "couples" will be used, inserted in different parts of the furnace, and separately connected with the board, so that the reading of any thermometer can be taken and any discrepancy in the heat of different points of the furnace can be quickly remedied. It is interesting to notice that the voltmeter is so extremely sensitive that variations of heat down to 0.5 deg. were easily noticeable in the trial test. The greatest temperature recorded was 1,300 deg. C., equal to 2,372 deg. F.—John P. Bray, United States Consul-General.

HIGH PLANER SPEEDS.

With the introduction of high-speed steels greatly increased cutting speeds were at once made possible on lathes and other tools where the work was constantly revolving in one direction, but the planing machine stood out as being the one tool where full advantage of these steels could not be taken, consequent upon the increased strain thrown upon the driving gears at the moment of reversing, when running at accelerated speeds. A patented invention of Smith & Coventry, Ltd., Manchester, England, does away with this difficulty by allowing the momentum of the table to spend itself before calling upon the gearing to bring about the return. Further, the energy created by this momentum is stored up in a powerful spring, which, as soon as the table gets to the end of the stroke, assists the gearing to start it off again in the opposite direction. In small machines this spring will start the table without the assistance of the belt. Having overcome the question of the reverse, the cutting speed depends somewhat upon the class of work to be done, but both it and the ratio of the return can be regulated to the wants of the purchaser. Stock machines up to 3 feet wide are built with a return of 4 to 1, and above this size 3 to 1, but, as stated, these ratios can readily be altered even in machines in stock. For sizes up to 3 feet, a cutting speed of 40 feet per minute, and a return of 160 feet a minute is recommended. Above 3 feet size, 30 feet cutting speed and 90 feet return. The table is driven by rack and pinion, and slides on flat surfaces, friction is thus greatly decreased, and the tendency to lift when side planing entirely done away with. Both horizontal and vertical surfaces are oiled by a self-acting device. The tables are of very deep section. The cross slide in the smaller machines is raised and lowered by hand, and can be manipulated from either side of the machine. In the larger machines it is raised by power. The tool box is self-acting in the horizontal, vertical and angular cuts, and includes a device which lifts the tool off the work during the return stroke. It can be controlled from either end of the cross slide. Driving.—All gears, including the rack, are cut from the solid, the driving belts are shifted one after the other, preventing noise and jar. The machine can be started or stopped from either side of the bed. The Canadian representatives, Peacock Brothers, Canada Life Building, Montreal, will be pleased to give further particulars of this efficient tool.

CARBON VS. METAL BRUSHES FOR DYNAMOS.

A writer in the Electrical Review (London), asserts that the one redeeming feature of the carbon brush for dynamos is its non-sparking tendency, which, in his opinion, does not compensate for its bad features. The carbon brush practically necessitates large commutators and extra expense of brush gear, large shafts and longer machines, and therefore, must increase the cost of production by a large amount. Especially is this the case where large currents have to be dealt with. This practice results from the designer's doubt of the efficacy of metal brushes. Carbon brushes not only increase the first cost, but lower the efficiency, so that it frequently happens that this might be increased 2 or 3 per cent. by the use of metal brushes. Consulting engineers demand carbon brushes, unmindful of the fact that so long as sparkless commutation is secured it is immaterial of what the brush be made. Comparing the design of a commutator for a six-pole 88-kilowatt parallel-wound armature for carbon and for metal brushes it is found that the use of carbon necessitates three times as many brushes as the metal. For the former the commutator must be 17 inches long, and for the latter only 6. The watts lost, due to the friction of the carbon brush, number 1,025, as against 205 for metal. The watts lost, due to the resistance of contact of the former, are 1,260, as against 434, making the total loss 2,285 watts for carbon and 639 for metal. The watts lost per square inch are 2.51 for carbon and 2 for metal. The commercial efficiency with the carbon brush is 91.8 per cent.; with metal, 93.4 per cent. The chief virtue of the carbon brush is its high specific resistance, which facilitates sparkless commutation. To secure a similar condition with metal brushes they may be subdivided with an insulating partition between the portions; or the central layers of metal may have a higher specific resistance. Where a reversible motor is employed a radial brush is necessary, but it would not be impossible to construct a satisfactory brush of this type out of metal.

—The business district of Hague, a village twelve miles south of Rosthern, N.W.T., was destroyed by fire on October 24th. Loss, $40,000; some insurance.

—An extensive deposit of high-grade limonite iron ore has been located about one hundred miles east of Edmonton. E. McAdam and A. Johnson, of Edmonton, are the owners.

ENGINEERING APPLIED TO HORTICULTURE.

There are few, if any, industries in late years that have made greater strides on this continent than that of the growing under glass of cut flowers.

Until recently this trade was mostly in the hands of small local growers supplying their immediate neighborhood—whose methods were taken from old country practice of many years ago. With the extension of our towns and cities, together with the increased wealth of their inhabitants the demand for fresh flowers has commonly exceeded such a supply, with the result that this business has been getting more into the hands of larger growers, or of companies specially formed to operate on an extensive scale. Thus the construction of greenhouses has become a special architectural and engineering question. Amongst the many

As will be seen the roof is of a single span, now made up to 30 ft. in width. This leaves the beds clear of the usual posts that interfere with the work and cast shadows on the flowers. The principals placed every 12 ft. 6 in. are of truss construction, the truss rod being only ¼ in. diameter, which casts practically no shadow. The purlins are also of a skeleton truss formation, the truss rods being wire 3/16 in. diameter, and the compression member ⅓ in. diameter of round iron. The complete distribution of light will be seen in the view. The drainage of the roof is accomplished by carrying the water through hollow roof supports shown as arches to large drains placed under the walks. These serve the double purpose of keeping the walks dry and providing escape for roof-water, thus doing away with the heavy shadows of gutters of ordinary construction. This method is important when it is considered that the new green houses are frequently a thousand feet long.

engineering firms that make a specialty of this work on the American continent, the King Construction Co., of 32 Church St., Toronto; Robert W. King & Co., being their engineers, may, we think, be fairly mentioned as having brought out the greatest number of improvements in this line.

This company has a branch in North Tonawanda, N.Y., to supply the demand for their improvements in the United States. Amongst their specialties are an iron skeleton construction of the greenhouses themselves, set in concrete foundation, the effect being to obtain permanency and rigidness with the least possible obstruction to light. Views and description of their more recent structures are here given.

Their machine for the automatic regulation of the temperature of the houses has already been described in these columns.

Part of one of five sections of the U. S. Cut Flower Co's green houses at Elmira. When completed these green houses will contain over a million sq. ft. of glass.

From Mr. King we have obtained an account of more recent improvements in the heating of greenhouses, including a description of his company's steam boiler, automatic stoker, and economiser system.

Owing to the greatly extended dimensions called for in greenhouse construction, it has become necessary to increase the size of the boiler units, and to use steam more largely as compared with hot water.

The larger plants no longer place their boilers in a cellar in order to obtain a gravity return of the condensed water. While boilers had to be in a cellar seldom more than 10 feet deep, and often not that, owing to lack of height they could only be made in comparatively small units covering a proportionately larger area of surface to obtain the necessary power. Hence we supplied only units of from 10 to 40 h.-p. This went very well while the average demand for any one plant did not exceed twenty thousand square feet of glass, while the majority would be far below that amount. The company's last set of plans made for the United States Cut-flower Co., of Elmira, New York, embrace in one plant heated from a single station one million square feet of glass, probably the largest single plant in the world. The power used is 2,400 horse-power. The purport of this plant is to supply the wholesale dealers mainly for New York market. The ground purchased for the purpose of this plant is 68 acres, the power station contains four batteries each of six units of 100-h.-p. per unit. Each unit is provided independently with its own economiser. Though some experimenting has already been done by us in Canada with economisers in greenhouse heating, it has been met with considerable opposition and prejudice on the part of proprietors lacking in that patience, perseverance, and we might add confidence, necessary for success. The result is that the lead in greenhouse engineering, of which the Canadian florists were once so justly proud, is as far as this item is concerned, passing to the United States. The company mentioned will probably be the first florists on record to install and operate a complete economiser system in connection with a greenhouse heating plant.

The Boilers.

Figs. 1 and 2 are from the King Construction Co.'s working drawings of boilers being erected. Each unit or pair of shells contain 10,000 square feet of fire surface over one fire—and are of the water-tube type, so as to give a quicker response to the firing. The shells have some fall to the back, which is increased again in the tubes by the extension nipples between the back head and water boxes. The circulation in the two upper horizontal rows of tubes is assisted by circulating plates shown in the front water boxes. Each water box contains two upright rows of tubes. This enables a much larger circulating connection from the water boxes to the shell than where only one row is used, so that as great a slant of the tubes is not required to enforce circulation. This gives room at the back end under the tubes for the introduction of economiser surface

A baffle plate is inserted between the economiser and the boiler, which plate is easily removed in case of repairs

The Economisers

Are of novel construction: they are formed of horizontal 4½ inch diameter cast iron tubes, mounted on a car that can be run out from under the boiler for convenience in internal cleaning or repairs. These tubes are set practically level, the circulation being made as follows:—Inside of each tube is a light circulating tube connected to the pipe where the water enters. This passes along the inside of the tube with an upward grade, conducting the water to the further end; the water then works back along the 4½ inch tube to the exit leading to the entrance of the tube above, eventually passing through pipes at the sides of the furnace to enter at the front end of the boiler shells. The outside surfaces of the economisers are cleaned by a hand brush from the back end much in the same way as the tubes in fire-tube boilers are cleaned. The tubes being water-tubes, of course, have the same advantage as other water tubes of being partially self-cleaning.

The inside of the tubes is easy of access for removing scale. The slackening of set-screw in yolk enables the tube

cover to be removed; the inner circulating tube is also removable. No economiser can have full effect unless cold feed water is used, and the heat given off by the cooling utilized to good effect. To obtain this object the condensed water of the heating system is distributed in piping, along with the steam pipes; the sizes of the water and steam pipes being so graded as to obtain uniform radiation through their length.

The Stokers.

Ordinary grate bars are shown in the plans. The boilers are fitted so either ordinary grates or automatic stokers can be used. The stoker used is illustrated in figure 3. When stokers are installed a water-front will be placed above the fire doors, from which will extend loops of tubes which will support the fire crown. Removable covers on the water front will enable the inside of tubes to be cleaned of scale. Water will circulate through the tubes—by this arrangement a fire crown of any width can be supported.

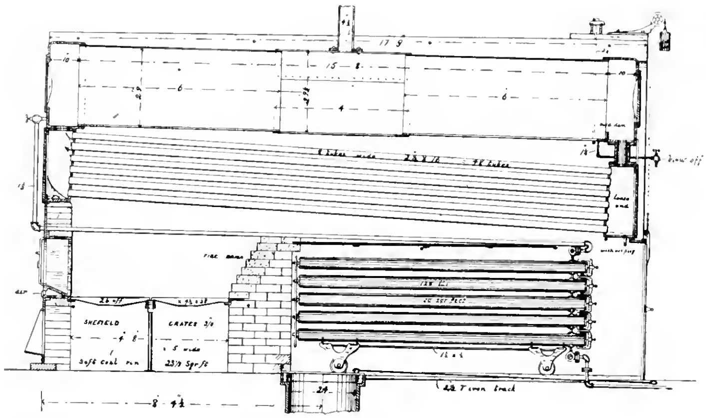


Fig. 1. The King Water Tube Boiler.

The stoker herein shown is one that has been under experiment for a number of years, and has been fairly well perfected for smaller units. Some 60 of them are in operation in various stages of perfection, but owing to the pressure of other business Mr. King has been unable to give the matter of design for the larger units his attention this season but considers the success that has been attained quite warrants a continuation of his work and the carrying of the stoker into general use. The design is patented in Canada, United States, Great Britain and France.

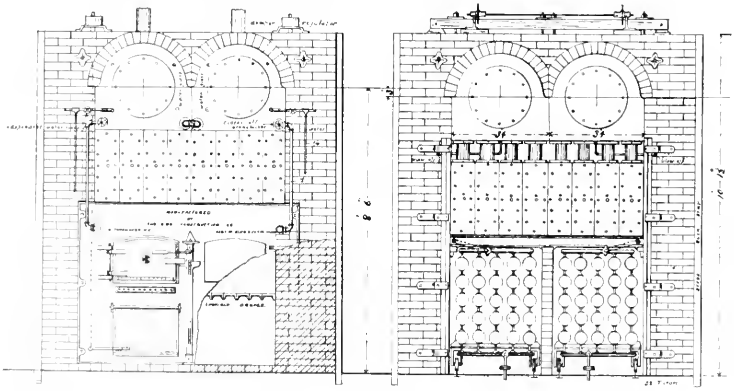


Fig. 2. Front View. Twin Setting. Back view door removed.

The operation and construction of the stoker may be explained as follows:—

The process consists in feeding in the fuel in an even layer the full width of the furnace with a constant feed. After leaving the mouth of the feed, the fuel runs down the first section of the grate area of its own gravity, assisted with pressure from behind, and covers evenly this section of grate, where it remains for a time in a stationary condition. The gases are extracted from it by the heat of the fire, which is thrown forward so as to pass over and near to the incoming fuel, and the fuel then cokes or welds together. So that the fuel may not escape through the grate, the air spaces of grates are made to enter horizontally. When the fuel has become coked, a series of pokers advance through the horizontal air spaces and push the coked fuel forward, dislodging it so it may pass on to the second section of grate area. On the withdrawal of the pokers, another lot of fuel passes on to the coking plate, or first section of grate area.

The second section of grate area is composed of alternately moving grates placed side by side and in a slightly inclined position. These act as rams, alternately relieving each other, and push the fuel forward. This section of grate area is kept in constant slow motion, the extent of which can be adjusted to suit conditions, and forces the fuel on to the third section of grate area. This section is made of ordinary stationary grate bars, which can be varied in length to suit the amount of grate surface desired to be used; this surface is horizontal, and presents enough friction to the fuel at this part so that the openings that otherwise might burn through are kept closed up by the constantly advancing and pushing fuel, thus keeping a compact bed and preventing any undue amount of draft or air from passing through the almost exhausted fuel.

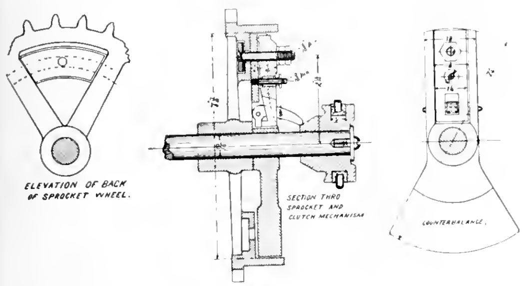
The fourth section of grate area is of ordinary bars also, but so arranged that it can be dropped into the dotted position by a lever passing to the front; the clinkers and other burned parts of fuel too coarse to go through the grates are pushed on to this drop grate, which is occasionally dumped, throwing them into the ash-pit. The drawing shows the mechanism by which the above is accomplished. A hopper is shown in outline above the feed, but is not required when the feed is fed from a spout. The feed consists of a series of screws placed side by side near to each other, but covering the whole width of the grate surface. There is, however, preferably a space and partition between the screws, causing weak places or cuts in the coking fuel, enabling it to more easily break into pieces. The coking plate sets at an angle of about 45 degrees. It has bars or solid portions connecting the shelves. The pokers are advanced in upright sets alternately, one set being retired when the other is in action.

The second section of grate area consists of bars easily replaceable for repairs, resting on reciprocating carriages, and preferably in order to simplify the mechanism required, the same action that reciprocates the grate carriages operates the pokers also, the poker drivers being attached to the grate carriages.

The reciprocating action is preferably accomplished by connecting the grate carriages to crank, each pair of cranks (reversed to one another) are set on a short connecting shaft with its driving wheel in the centre. A counter-shaft with pinions engaging in each gear drives them; this counter-shaft is driven by a ratchet wheel operated by a paul and lever connected to the main shaft of machinery by an adjustable crank and pin, by which the number of notches the paul will take can be regulated. Worms on this main machine shaft operate into worm wheels, as shown driving the feed screws.

It will be noted from the drawing that the coking plate is arranged so as to be partitioned off from the ash-pit proper, and has a separate door or damper from the ash-pit door, so the draft to it can be independently regulated. The fire door is shown immediately back of the hopper, and is raised bodily out of position by chains and a lever. A ratchet wheel on lever shaft and paul, not shown, holds it in elevated position when required. The door is hollow, with partitions at close intervals joining the inner to the outer plate. The upper part of door has an air-admitting damper, which when open allows air to pass through the door between the partitions in a direction to impinge on the entering fuel, and is heated on its way.

The heated products of combustion pass from the furnace and exhaust themselves first in contact with the fire surfaces of the boiler. Before they can reach the exit flue (which in this design passes downwards into an underground tunnel, connected with smokestack), they are made



Friction Clutch Start and Stop Motion for King's Automatic Stoker.

to pass the economiser which has 50 per cent. of fire surface in addition to the boiler proper, thus abstracting additional heat from fuel. In experiments conducted by Mr. King last winter, no difficulty was found in reducing the temperature of the water of condensation from 212° to 60° even though the houses were heated to 68° or 70°. The condensation first flows through a syphon or trap that separates it from the steam to a pump which forces it back to the boilers. On its way from pump to boilers it is forced through a number of small pipes dispersed in the lower and colder portion of the houses, thus reducing its temperature to the degree mentioned, at the same time that its heat so dissipated is usefully employed in the heating of the houses. It is a simple matter for engineers to calculate the amount of saving in fuel that can be so effected.

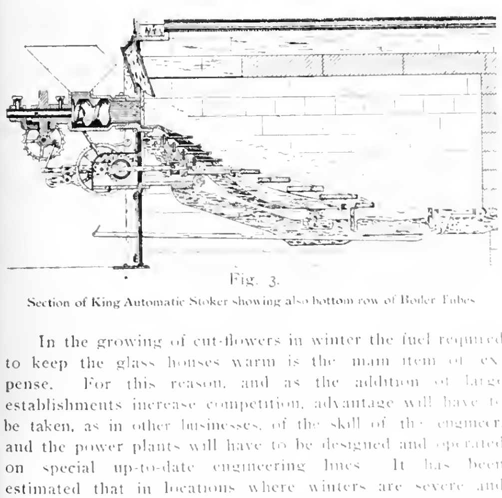


Fig. 3.

Section of King Automatic Stoker showing also bottom row of Boiler Tubes

In the growing of cut-flowers in winter the fuel required to keep the glass houses warm is the main item of expense. For this reason, and as the addition of large establishments increase competition, advantage will have to be taken, as in other businesses, of the skill of the engineer, and the power plants will have to be designed and operated on special up-to-date engineering lines. It has been estimated that in locations where winters are severe and fuel expensive, the saving that can be effected in the boiler room or power station by special engineering as compared with ordinary practice will itself pay a fair dividend on the whole investment.

WINNIPEG NOTES.

CORRESPONDENCE OF THE [illegible].

Many people in Eastern Canada [illegible] regarding the character and consequence of the movement of population from the Northwestern States which [illegible] so strongly towards Manitoba and the North-West Territories. Will these immigrants become good Canadians, or will they make trouble when they become more numerous by inciting some kind of Jameson raid from the border states? Your correspondent has talked with a great many people, some of whom are neighbors of the new settlers from the States, or are intimately connected with them in business, and the facts and opinions gathered justify the prediction that no anxiety need be harbored on this score. It is quite true that in certain localities groups of United States settlers of the older type have planted themselves in solid colonies, and give offense to their Canadian neighbors by flaunting the Stars and Stripes on frequent occasions, and make it evident by their conversation that they have yet to learn there are other nations besides the United States. These people, who would be classed among the noisy jingoes at home, will probably, many of them live and die in their national prejudices, which they have imbibed from their old school books, but their prejudices will not outlast their own lives. Their children will be educated in Canadian schools, with Canadian text books which will throw a different light upon the history of "the continent to which we belong." These children will grow up to regard Canada as their home, and will love their playmates of Canadian descent as if the American Revolution had not estranged their great grandfathers. Meantime, the spread-eagle talk of this class of United States immigrants is, as a rule, wisely treated with good-natured tolerance, which will sooner or later show that Canadians have a broader conception of the word "liberty" than they who make it their boast without possessing the spirit of it so deeply. The class just referred to is happily not the majority of the new-comers from the States. There is another and quite as numerous a class of American-born settlers, who have been quick to learn since they came here that in all that makes for true liberty the Canadian constitution is on the same high level as that of the United States, both having their base upon the conceptions of liberty and law derived from the common mother constitution. They also recognize that generally speaking, the administration of law is better carried on than in their own country; and as they have no disabilities, but are treated as our own people, there will never be any grievance upon which to base a Jameson raid. But apart from these considerations, it appears that fully half—some say two-thirds—of the settlers from the United States during the last two years, turn out to be returned Canadians—men who moved from Ontario, Quebec, and the Maritime Provinces ten, twenty and even thirty years ago, and settled in the Western States, but who either to better their own individual condition, or desiring to end their days in their native land, return to where the old flag is flying. Leaving out of account this large proportion of repatriated Canadians, a considerable proportion of the remainder is composed of people of European birth, who not being born to United States institutions, will be no more wedded to them than to Canadian institutions. From all these considerations, there need be no fear as to the political future of the United States immigrants into the Canadian West.

As mentioned in last letter, Winnipeg has arrived at that stage of development when make-shift structures give place to works of a more permanent kind, and when, along with the continued development of the wholesale trade, manufactures on a larger scale are called into existence. [illegible] a large demand for machinery and [illegible] of a varied character, and United States firms are keen after orders. Eastern Canadian firms are now in evidence here now, but have, in too many cases, been very slow in taking in the situation. Between foreign and Canadian firms [illegible] week passes but some new warehouse, or branch warehouse, is opened for business or some branch factory started.

The conditions are not yet favorable for small factories, owing to the lack of cheap fuel or cheap electric power, but electric power is likely soon to be supplied. If it can be brought in under civic ownership, or at least under effective

civic control, it will be well for the industrial development of the city.

The Winnipeg Electric Street Railway, which still uses coal, develops rapidly, notwithstanding the high cost of its fuel. Coal can be bought at the Crow's Nest Pass at $2.50 per ton, but it costs $5 a ton for freight, so that it costs $7.50 before it can be laid down in Winnipeg. Eastern coal costs 50 cents a ton less, so that Pennsylvania holds the trade in the anthracite variety. With coal for manufacturing purposes at such prices, any project for transmitting power to the city is of great interest. The proposition which appears most likely to materialize is that now on foot by the Winnipeg General Power Co.—a corporation closely associated with the Street Railway Company—which proposes to bring power from Lac du Bonnet, seventy miles distant. The power house and dam are under construction this year, and are to be finished in 1905. The ultimate power available is 30,000-h.p. Meantime the Street Railway Company which has thirty miles of track in operation, and is steadily extending its lines as the area of the city expands, is providing for its needs by building new repair shops and car shops. These shops are 100 by 250 ft., exclusive of boiler room and heating plant, and here the company will make its own repairs, and build all its open cars in the future. The shops are to be finished before the close of the year. This company does the commercial lighting and furnishes electric power, and also operates the gas plant, which is being extended by a new coal gas plant of a capacity of a million feet a day. The gas plant will also be finished before the close of the year. The company now has 60,000 incandescent lights on its circuits, but the power is chiefly confined to elevator work, the elevators being nearly all operated electrically.

Other power for Winnipeg is that which will be available when the Government dam at St. Andrew's Rapids is completed.

As may be imagined, the remarkable growth of Winnipeg's population entails heavy responsibility as well as prodigious work upon the city engineer's department, but under C. H. Ruttan this work is being carried on to the great credit of himself and his staff. A pumping station and plant is now being constructed at a cost of $80,000, and new water mains are being laid to cost over $90,000. Asphalt is now being favored as a paving material, the asphalt paving now in hand amounting to $273,000, compared with $240,000 of macadam, and only $6,000 of cedar blocks. Granolithic sidewalks are being put down to the value of $71,000, and wooden walks to the value of $15,000. Sewers to the value of $390,000, and other works will make a total of a million dollars now being spent in the engineer's department. The situation of Winnipeg on a dead level plain makes the problem of perfect sanitation of the city a difficult one, and if Mr. Ruttan and his staff works out this problem right, they will leave a worthy memorial to their names.

WESTINGHOUSE AWARDS.

The various Westinghouse companies represented at the Louisiana Purchase Exposition have received in all twelve grand prizes, eight gold medals, four silver medals, and one bronze medal. They received the special award in the department of machinery for "the best, most complete, and most attractive installation."

The following were the twelve grand prizes: Westinghouse Electric and Manufacturing Company, for "Alternating current generators and motors, alternating current turbo-generator installation, static transformers, and rotary converters." Westinghouse Electric and Manufacturing Company, for "Direct current generators and motors." Westinghouse Electric and Manufacturing Company, for "Electric railway motors, alternating current and direct current, and control systems for single and multiple unit operation and for mining and industrial locomotives." Westinghouse Machine Company, for "Horizontal gas engines and steam turbines." Westinghouse Air Brake Company, for "Air brakes and friction draft gears." Westinghouse Traction Brake Company, for "Brakes for electric cars." American Brake Company, for "Driver brakes." Westinghouse Automatic Air and Steam Coupler Company, for "Air and steam couplers." Westinghouse Brake Co., Limited, London, England, for "Air brakes and accessories." Westinghouse Company, Limited, of St. Petersburg, Russia, for "Air brakes and accessories." Union Switch and Signal Company, for "Signal system." Cooper-Hewitt Electric Company, for "The development of the mercury vapor arc lamp."

The eight gold medals awarded were as follows: Westinghouse Electric and Manufacturing Company, for "Complete switchboards and controlling apparatus, and the application of electric motors for mechanical purposes." Westinghouse Electric and Manufacturing Company, for "Alternating current, direct current, and Bremer arc lamps and arc lighting systems." Westinghouse Electric and Manufacturing Company, for "Electric measuring instruments." Nernst Lamp Company, for "Nernst lamps." Cooper Hewitt Electric Company, for "Vapor lamps for photo-engraving." Pittsburg Meter Company, for "Water and gas meters." Westinghouse Electric and Manufacturing Company, for "Industrial betterment work." Westinghouse Air Brake Company, for "The housing of the working-classes."

The four silver medals were given to the Westinghouse Electric and Manufacturing Company, for "Switches, fuses, and wiring appliances." To the Sawyer-Mann Electric Company, for "Incandescent lamps." To the Bryant Electric Company, for "Electric light fittings," and to the Societe Anonyme Westinghouse, Havre, France, for "Gasoline automobiles."

The bronze medal went to the Perkins' Electric Switch Manufacturing Company, for "Electric Switches."

CANADIAN SOCIETY OF CIVIL ENGINEERS.

The autumn session opened on the 20th ult. with a meeting of the General Section, at which a paper was read on: "Loss of Heat from Iron Pipes," by R. W. Leonard. Duncan Macpherson, president of the section, occupied the chair. J. M. Nelson was appointed secretary of the section. A short discussion followed, Messrs. Durley, Kerry, Rhys, Roberts and Ross taking part.

A high-grade galena ore was struck recently at the Fog-horn mine, near Ymir, B.C.

—The corporation of Napanee, Ont., have retained the services of R. S. Kelsch, consulting engineer, Montreal, in connection with the new electric light plant and water-works to be installed by the corporation.

—R. S. Kelsch, consulting engineer, Montreal, has returned from Vancouver Island, B.C., which place he visited in connection with a hydro-electric development to cost $2,000,000. The property is controlled by Montreal capitalists. The transmission will be 56 miles at 60,000 volts.

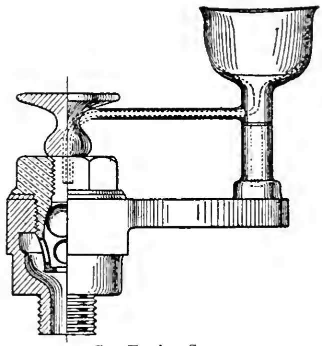
—Mention was made in our September number of the extent to which train lighting by acetylene had been carried on by the Canadian Pacific Railway. The Canadian Northern has also adopted acetylene and has equipped a plant at Winnipeg for making the gas from carbide and for purifying, drying and compressing it for the individual tanks attached to the cars. The reservoir at the Winnipeg plant has a capacity of 30,000 ft.

—The new water-power plant at Niagara Falls, Ont., will have to contend with the greatest enemy of Canadian water-powers, floating and anchor ice, and R. S. Kelsch, consulting engineer, Montreal, has spent considerable time at the Falls recently, studying this matter. Mr. Kelsch's experience at Lachine Rapids, and the successful means employed to overcome the great difficulty experienced by the Lachine Company will be of great assistance in formulating successful plans for handling ice at Niagara Falls.

—R. S. Kelsch, consulting engineer, Montreal, was selected as arbitrator to adjust the differences between the Canadian Electric Light Company and the Levis County Railway Company, consisting of the interpretation of an existing power contract, four suits and one damage claim for $10,000, and to draw a new contract for power for the railway company, the companies signing a bond of $5,000 to abide by the decision of the arbitration. The award has been made and the companies have complied with same.

GAS ENGINE STARTER.

The accompanying sketch from the Electrical Engineer shows a starting apparatus for gas and oil engines. The construction is simple, the only internal working part being a steel ball valve. To start the engine, the crank is placed in such a position that all the valves are closed; the screw plug on the top of the starter is then removed, and the ball pressed down with a prober, which is supplied with the starter. The required quantity of gasoline is then poured into the funnel-shaped reservoir,



Gas Engine Starter.

and by it passed through the projecting pipe into the cylinder end. The funnel pipe is then twisted out of the way. The fly-wheel is then moved a little forward in order to draw in the requisite amount of air through the starter. By bringing the crank nearly back to its original position, compression is obtained and the ball is forced back on to its seating. The prober is again used to press down the ball until it falls by its own weight, then by placing a lighted match over the hole in the starter the engine is started without further manipulation. The screw-plug is then replaced. The quantity of benzine required is small, being, it is said, about a thimbleful to start a 50-horse-power engine and about half this quantity for a 10-horse-power engine.

CANADIAN WOOLEN MANUFACTURERS.

(Canadian Journal of Fabrics).

What are the causes of the difference in the cost of producing woolen goods here and in Great Britain?

1. Higher rate of interest on capital invested in Canada.

2. Increased cost of equipping a mill in Canada, this difference being estimated at 30 to 40 per cent. The Canadian manufacturer pays a duty on all his machinery, though by this duty on spinning, weaving and finishing machinery no home industry is protected, since none of that class of machinery is made in Canada. If the Government really desired to give a "preference" to British goods without injuring any established Canadian industry it would make such machinery free.

3. Higher rate of wages in Canadian mills. The wages of skilled operatives are estimated to be on the average, 50 per cent. more than those paid for corresponding work in Great Britain, and in every branch, skilled or unskilled, the cost of labor is higher in Canadian mills. The Canadian mill hand lives in greater comfort than his British contemporary, and it is a question whether our politicians or manufacturers would have it otherwise if they could.

In these considerations we are excluding from view the custom mills of this country, many of which have carding and other machines of a kind unsuited to cope successfully with trade orders under present day conditions. But it ought to be known to those having only a moderate acquaintance with the textile trades that as a rule these mills were never designed to live upon orders from the trade as all mills in the Old Country are. Their very name of "custom mill" implies that. When the country was younger, and every farmer raised sheep, while every farmer's wife and daughter could spin, weave and knit, the custom mill throve; but, regrettable as it may appear to many who have watched the change in our domestic conditions, the custom woolen mill along with the hand-loom and the spinning-wheel is doomed to extinction, no matter what the duties on imported goods or what the preference to British goods.

CAMPBELL SWINTON CORRECTED.

Editor Canadian Engineer:—

Sir,—I would like you to publish this letter as a correction of one of the statements made in the excellent article on "Electricity from Water Power," by A. A. Campbell Swinton, M.I.C.E., M.I.E.E., appearing on page 307 of your October number, particularly as the information given purports to have been given by me.

I wish to state positively that none of the plants given in table in the first column of page 307 was installed by the Stanley Electric Manufacturing Company. Immediately on the receipt of advance proof of that paper from Mr. Swinton I wrote him, asking that this be corrected, and had hoped that it would be before appearing in the press, as I received a letter from his office stating that the matter would have his early attention.

I regret the publication of this information before Mr. Swinton had had the opportunity to make the correction, as it ascribes to the Stanley Electric Manufacturing Company the credit for installing plants which it had not, and which it had no intention or desire to claim.

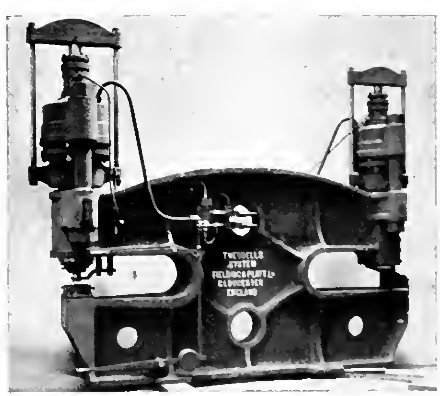
Trusting that you will publish this letter, and that it may correct the error so unwittingly made, I am,

Respectfully yours,
C. C. CHESNEY.

Pittsfield, Mass., Oct. 11th.

HYDRAULIC PUNCH AND SHEAR.

Amongst the heavy tools ordered by the Canadian Pacific Railway Co. for their new shops is a Hydraulic Punch and Shear, here illustrated, made by Fielding & Platt, Ltd., of Gloucester, England. This machine has gaps 48 inches deep, being powerful enough to punch 4 inch holes through 1 inch



Hydraulic Punch and Shear.

plate, and shear 1¼ inch plate. The body is cast steel with loose cast steel cylinders lined with gunmetal, rams of close grained cast iron. Fielding's patent balanced piston valves are used for operating the machine and can be worked either by hand or foot. Although this machine was only lately made, the Canadian Pacific Railway Co. have given an order for a duplicate machine to Fielding & Platt.

The Canadian representatives of this firm are Peacock Brothers, Canada Life Building, Montreal, who have been for some years practically the only firm making a specialty of importing heavy and special British tools.

A VISIT TO THE WORLD'S FAIR.

An ideal time to visit the World's Fair at St. Louis is during the period indefinitely known as Indian Summer. Your representative spent the first week of October on the grounds, and found the weather ideal. After leaving a frost-bitten country where most of the out-door floral decorations have disappeared, and the woods are donning their autumn tints, it is a delightful surprise to find one's self in a latitude where it is still summer. On the fair grounds, the lawns and flower-beds are in their prime, and their luxuriant colors together with the light summer garments so common among the crowds, lead one to imagine that it must be August instead of October.

My route lay by the Grand Trunk Railway to Chicago, and thence by the Illinois Central. With all the luxuries of modern travel we sped through Western Ontario with its rolling farms and woodlands, and past the oil district where the rigs dotted the landscape like trees. Passing through the Sarnia tunnel is a unique experience, since one travels under a river without ever seeing the water. It is to be hoped that electric traction will soon be substituted for steam, through the tube, both for comfort and for safety. Gas is unpleasantly noticeable as a train passes through, and how dangerous it can be, has very recently and grimly been brought to public notice. Over the Grand Trunk Western from Port Huron to Chicago the ride was most delightful, and there our car was attached to the Illinois Central train which carried us straight south during the night, and showed us the cornfields and mules in the morning.

The Fair is certainly a great show and well worth a visit. It is large and it is impressive, but naturally it impresses different minds in different ways. Your correspondent confesses that he was not as much struck with the first view of the grounds and buildings as he might have desired. While the advancing season has probably improved the appearance of the natural decorations of the grounds, it is an undeniable fact that age does not improve plaster and staff. Things are not looking shabby yet, by any means, and the best possible care is being taken of the buildings, but an occasional patch in the plaster disillusionizes the onlooker, who would like to think that he is looking at stone.

It was, however, when I looked into the Fair rather than at it, that I was impressed. Here are countries from Europe, from Asia,—from every continent, in fact,—engaged in a friendly rivalry in giving the visitor an adequate idea of the social and industrial conditions prevailing among their several peoples. As exhibits were classified and divided among the different buildings according to their character, one could not find the various sides of any particular people's life exemplified in any one place. Here you see them conducting railroads, there you are shown how they furnish their homes, yonder you may examine their form of education, and in another place, they exhibit their skill in art. In some ways this arrangement is more impressive than any other could be. For instance, no matter where one goes, one cannot travel far before coming on a German exhibit. The same way with Japan; whether you go to manufactures, mines, transportation, agriculture, or what not, even sauntering down the Pike, you will meet Japan. The same thing is doubtless true in large measure of other countries, but Germany and Japan impressed me more than the others.

The exhibits of Great Britain and Ireland are prominent in nearly all the buildings, and other parts of the Empire show up very well. France and Germany for the most part show exhibits from their colonies in close proximity to the motherland; but the members of the British Empire are quite separate and distinct from each other. Perhaps that fact is an indication of a fundamental distinction between our Empire and others.

New Zealand has two or three exhibits, and does some aggressive advertising; Egypt has displays in two or three places; Rhodesia has a stand; India and Ceylon are prominent; and there are probably other exhibits from outlying members. Australia, however, is a disappointment. Possibly I missed their main exhibit, but all I saw was a booth from New South Wales.

Canada has exhibits in nearly all the large buildings, besides two buildings of her own,—the Government building, and a special forestry building. The exhibits are all tastefully arranged with a view to making the best impression.

Some exhibits are apparently arranged on the assumption that visitors will stop for half an hour or so and examine that which is shown. Not so the Canadian exhibits. Our permanent exhibition commission know their business, and know that the average visitor at a fair is there to see as much as possible in the least possible time, and our exhibits are designed to meet that condition. A visitor in the Mines and Metallurgy Building, who steps into the Canadian exhibit and looks around for five minutes will get an idea of the principal mineral resources of the country, and if he has any eyes to read the brief but telling legends that adorn the pillars, he will know that this country takes an important place in the world's production of nickel, asbestus, graphite, mica, etc.

The average visitor at a fair is there not only to see all he can but also to get all he can. Nearly all exhibitors issue some sort of circular or souvenir for distribution, and a visitor, picking up such things for a few days, is subject to a sort of kleptomania, and will seize anything of convenient size which is lying loose. The Canadian Commissioners met this condition exactly when they issued a series of handbooks to be distributed at the various exhibits. These books are got up neatly and tastefully and deal with various topics, one with agriculture, another with the economic minerals of this country, another with the forest wealth of Canada, etc. Besides these there is issued a larger book, in very durable and attractive binding, giving general information about the country, which is distributed free at the Canadian Building.

Other displays which help to advertise Canada are the Intercolonial Railway display, which points to Canada as the sportsman's paradise, and the Grand Trunk Railway booth, which advertises the Kawartha district by paintings and moving pictures.

PAVING A CANADIAN CITY.

FROM A PAPER READ BEFORE THE UNION OF CANADIAN MUNICIPALITIES, BY A. O. GRAYDON, CITY ENGINEER OF LONDON, ONT.

I must preface this report by stating that I became an official of the city in 1888, as assistant City Engineer, and assumed my present office in 1891. Quite a number of pavements were, of course, laid previous to those years. I would also observe that the Board of Works, under whose control the expenditure on the streets is made have had their estimates so cut down by the council each year that it has prevented them from carrying out improvements which they otherwise would have done.

The City of London has 133 miles of streets of which the greater portion are surfaced with pit or river gravel. Fortunately the city abounds with the best gravel, and until within the past four years, these streets were fairly well made at a small expenditure, but since then the contractors and teamsters supplying gravel have so increased their prices that it is nearly as cheap to buy broken stone, and certainly in the end it is much more economical. The reason why gravel has increased in price is due to the large quantity used by the contractors for cement walks.

The soils we encounter in constructing roads and pavements throughout the city are, as a general rule, of an excellent character and form a good foundation and seldom require under-drainage, except in what is known as London South, and the south-western portion, chiefly occupied by the business portion of the city. The formation underlying the remaining portion of the city is composed of red sand and gravel.

The city in 1896 purchased a 12½ (long) ton roller from

the Harrisburg, Pa., Engine Company, and it has been of the greatest benefit. If a good coat of gravel about 10 inches in depth is laid on a sub-grade properly prepared, the road given a crown of 9 or 10 inches, and a cement curb laid on each side and then thoroughly wetted and rolled, you have an excellent road for residential streets, but it is not a permanent road, and requires frequent repairs to keep it in anything like a satisfactory condition. A road of this class made with unscreened pit gravel will cost, here, about 60 cents per square yard. The cement curb (6-in.) costs 25 cents a lineal foot, and a combined 6-in. curb and a gutter 15-in. wide costs 50c. a lineal foot.

I have very strongly opposed the further use of gravel for our streets and advocate that broken stone be used entirely where permanent pavements are not likely to be constructed in the near future. In this I am supported by the Mayor and the Chairman of the Board of Works.

Coming down to the first permanent pavements laid in the city, we have Dundas St. from Ridout St. to Richmond St., a length of 1,166 feet by 46 feet wide laid with cedar blocks on a stone foundation in the year 1881. The life of this pavement was then estimated to be 20 years and debentures issued to mature in that length of time. The annual frontage tax was paid until 1895, when the City Council cancelled the remaining six payments and relaid the street with the present sheet asphalt pavement.

The next pavement was on Dundas St. from Wellington St. to Richmond St., laid in 1883, in the same manner, with 20 years as the life of it. These payments were also cancelled in 1895 or eight years before the final payment came due.

Richmond St. from the G.T.R. to Fullarton St. was laid in 1883 and the payments cancelled in 1895, and the street repaved with the present sheet asphalt. The city had of course to assume all the cancelled payments on the cedar block pavements; the average cost of the above-named cedar block pavements to the ratepayers was 22 cents per foot frontage, for a term of 20 years

I need hardly tell you these pavements were worn out long before 1895, when the payments were cancelled with from six to eight years yet to run.

Dundas St. from Wellington St. to Waterloo St., 660 feet, was laid with cedar blocks in 1888, under a ten-year life. This block has been completely worn out for several years.

Dundas St. from Waterloo St. to the Western Fair grounds, a length of some 6,000 feet, was laid with cedar blocks, laid on 8 inches of gravel, in 1892, with an estimated life of ten years. This pavement is also worn out, and will in all probability be replaced with a better class of pavement next year.

King St. from Ridout St. to Maitland St., a distance of 5,200 feet, was laid in different sections in 1891 and 1892, with a ten-year life.

The above mentioned cedar block pavements comprise the great bulk of that class of pavement laid here, there were four short blocks laid about 1892, all of which are worn out. The total length of cedar block pavement laid in this city was about six miles.

The next class of pavement laid was sheet asphalt on Dundas St. and Richmond St., constructed in 1896, with an estimated life of fifteen years, with a five-year guarantee. This pavement is laid on a 6-in. concrete foundation with 1-in. binder and 2-in. surface of Trinidad pitch lake asphalt, and cost $2.65 per superficial square yard. The contractors were called upon to repair in 1900, and they again had to repair in 1901, the year their guarantee expired, since then the city have had to repair each year at a cost of from $900 to $1,200 annually, this is exclusive of street railway portion, which has to be maintained by the company, and their repairs, I am informed, cost as much as the city's portion. The Street Railway Co. occupy 17 ft. ½ in., or that portion occupied by the tracks and 18 inches outside the outer rail. Under their agreement with the city they are compelled to pave or repave with like material to that used on the adjoining portion of the street at their own expense.

In the Street Railway portion 12-in. by 12-in. longitudinal beams of concrete are constructed upon which the rails are placed, the rails are tied together every 6 feet with an iron rod and then the whole is imbedded in concrete. The rail is 6½ inches deep and weighs 70 lbs. to the yard. This construction has not been successful and the rail is too light in weight and not of sufficient depth. The length of this pavement is 2,600 feet on Dundas St. and 1,800 on Richmond St. by 46 ft. wide, and cost (by contract under tenders), $1,200 to clean it from the 1st April to the 1st December, and the remaining four months of winter it usually costs about $150, which is equal to $1,350 annually.

The next class of pavement laid was the Warren's bitulithic, laid in 1902 on Talbot St. from Fullarton St. to Oxford St., a length of 3,900 feet and 26 feet wide with returns at street intersections of 25 feet. This pavement is constructed by laying a foundation of 6 inches of broken stone passing a 3-inch ring and caught on a 1-inch ring, flushed with bitumen and well rolled, then ¾ of an inch of small crushed stone is swept over it to fill voids and then a coat of their patent cement. The wearing surface is 2 inches thick and is composed of 1¾-in. to minutest particles of hard crushed stone mixed with bitumen and heated to 250 degrees Fahr. and passed through a "twin pug" mixer and afterwards brought on the ground while hot, and spread with rakes, similar to asphalt, and then rolled solid. On this surface is spread another flushing coat of bitumen and then a thin layer of stone chips is rolled into it to give it a gritty surface that will not be slippery, and which gives horses a firmer foothold. The cost of this pavement was $2.40 per yard, and the combined curb and gutter was 50 cents a lineal foot with a ten-year guarantee.

Warren's bitulithic pavement was also laid on King St. from Maitland St. to William St. some 700 feet by 25 feet wide at the same cost per yard, and also on York St. from Wellington St. to Talbot St., a length of 2,000 feet by 40 feet, at a cost of $2.20 per square yard, the westerly block on York St. is traversed by the London St. Railway, and they paved (with the consent of the City Council by by-law), their track allowance with vitrified brick. The brick are of a very inferior quality, but I am of opinion that scoria block, vitrified brick or asphalt blocks are the best material for paving street railway track allowances on account of the vibration of the rail and also it is so much easier to get at their rail joints for repairs, etc. Sheet pavements are not calculated to stand the vibration of street car traffic and have proven unsatisfactory. Peter St. from Queen's Ave. to Dufferin Ave. was also laid with bitulithic in 1902 at $2.10 per yard, it is 25 feet wide by 500 feet long. This year the city awarded a contract for paving Wellington St. from Dundas St. to the G.T.R., 1,250 feet by 40 feet wide, 3-inch asphalt blocks. These blocks are laid on 5-in. of concrete, on this is ½-in. of cement mortar on which the blocks are laid. The interstices between the blocks are filled with a mixture of dry sand and cement, one to one, which is swept into all the spaces and afterward a coat of liquid cement is swept all over the pavement and when dry a layer of sand is swept over the entire pavement and allowed to remain two or three days, and afterwards swept off. The cost of this pavement was $2.00 per yard with a ten-year guarantee.

In the year 1900, the city awarded a contract for laying a tar macadam road on Queen's Ave. from Adelaide St. to Maitland St.; this was constructed with a 12-inch foundation being 4 inches of very coarse gravel and 8 inches of broken stone. The broken stone was heated in pans to a temperature of 240 degrees Fahr. and thoroughly coated with bitumen at the same temperature, this bitumen was composed of 10 gallons of coal tar to one gallon pitch and a small quantity of asphalt and sufficient was used to cover all the exposed surface of the stone. The stone was then teamed into the street while hot and immediately rolled into place. This 8-inch depth of stone was laid in two layers of 6-in. and 2-in., the lower layer being 2½-in. stone and the upper having stones of 1½-in. and under. The surface was finished with a coat of sand and bitumen of a thickness of ¾ of an inch and then rolled down. The easterly block between William and Adelaide St. was laid in warm weather, and now it is in first-class condition, but the westerly block to Maitland St. was completed under less favorable conditions, the cold weather having come on and on several occasions the snow had to be swept off the lower layer in order to put on the surface, the result being that this block required resurfacing. The cost of

this pavement was $1.10 per yard, which includes cement curb and gutter.

Macadam Pavements.

The following macadam pavements have been laid in this city by me by day work: Dufferin Ave. Wellington to Waterloo, in 1897; Dufferin Ave. Waterloo St. to Cartwright, in 1898; Wellington St. Dufferin to Central, in 1898; Wolfe St. Wellington to Waterloo, in 1898; Princess Ave. Wellington to Waterloo, in 1898; Princess Ave. Waterloo to Colborne, in 1899. These pavements have all a stone curb 4 by 18-in. with the exception of Dufferin Ave. from Wellington to Waterloo. They were constructed in the following manner: The road was excavated to the depth of 12 inches and made to conform to the required cross-section and then 12 inches of broken stone was laid on the sub-grade and thoroughly wetted and rolled and then one inch of crushed stone dust was spread on it and this was thoroughly rolled in. The cost of these pavements was about $1.05 per square yard, the stone curb was 43 cents per lineal foot in place. There is always a feeling in the minds of laymen that there is nothing like the macadam roads, and while I think they are very suitable for residential streets, yet they require continuous and systematic repairs in order to prevent the disintegration caused by traffic and water. Broken stone in available quantities should be kept on hand to repair these roads wherever a weak or defective spot appears in the surface in the same manner as these roads are cared for in England or the sections of a steam railway are cared for in the country.

This city has no brick pavements; the council has decided to initiate one on King St. from Wellington St. to Ridout St. one of the main business streets. Whether the property owners will ratify the council's action or not remains to be seen. I estimate this pavement laid on 5-in. concrete base will cost about $2.25 per yard.

General Remarks.

In considering the paving question of this or any other city, one must familiarize himself with the general conditions as they exist, by this I mean the nature of the street, its environment, its width, its levels for carrying the water off, its residents, or the nature of the business on it, etc., etc., also the capability of the property owners as to what frontage tax they are able to bear without being a burden. Then, again, you must consider the money available for keeping the pavements clean, for, as I have already informed you, it costs $1,350 a year to keep three-quarters of a mile of asphalt clean. For instance on a great many streets in this city which require to be paved in the near future the properties consist of wide frontages with comparatively inexpensive houses, and thus if costly pavements were put down it would practically be putting a mortgage on the properties; for instance, if a man has a frontage of 100 feet, and has a $1,200 dwelling on it, and you construct a 27-ft. roadway at a cost of say $2 a yard, means $35 a year or a mortgage (by the way of frontage tax), of $350. I use this illustration, as a great number of such cases (and many with greater frontages), exist throughout the city, as owing to its large area (4,478 acres), London is a city of wide frontages, and the population has not reached that stage which requires the utilization of all the frontage with revenue-producing buildings; more especially is this the case where the great majority of the mechanics and wage earners own their own homes, and where we have a large amount of available land not yet built on, although each day this is being quickly taken up and the city rapidly increasing in all directions. I desire here to say that I consider that much harm is done and the construction of many pavements defeated by too much zeal on the part of agents representing different classes of pavements and the property owners greatly confused and annoyed by the representation and requests made to them to sign petitions and contra petitions. I might instance that we have had in this city within the past two years at least three streets unpaved which without the action of such agents would now be paved, and to avoid and do away with this detriment to paving I think that the city council by a two-thirds vote should have the right to lay any class of pavement on any street on the recommendation of the City Engineer and from this decision from the city council the property owners should have no appeal. I would urgently suggest that your association take steps to have an act passed in the Local Legislature to that effect, and I would also suggest that you use your influence to have an Act passed in all the Provincial Legislatures compelling the use of wide tires.

I think you might discuss the question whether all horse and vehicle owners be charged a yearly license by which a fund could be created for the purpose of supplementing the yearly appropriation made to No. 2 Committee for street repairs. The appropriation for 1904 for grading, gravelling and repairing 133 miles of streets in this city, besides laying crossings and repairing plank sidewalks is $16,500, a sum quite insufficient for the work to be done.

We have a peculiar case on Dundas St. between Wellington and Waterloo streets which, as stated, was paved with cedar blocks long since worn out. This street has shops on the north side and the sidewalk is laid directly along the street line; on the south side is a factory, and the rest of the buildings are private dwellings and the sidewalk is put out 33 ft. from the property having a boulevard. The property owners on the north side want the pavement extended to the sidewalk, and they want the owners on the south side to pay one-half of this extra width of pavement on the north side, which they refuse to do, and the result is a deadlock and a disgraceful pavement in nearly the heart of the city. The owners on the south side petitioned for a pavement on their side, but the City Solicitor said it could not be constructed, and the City Council is helpless to act and their attempts at mediation have thus far failed. Under these circumstances, what would you suggest?

Cement Walks.

The city has about 100 miles of these walks already laid. They are constructed with 7 inches of coarse gravel well rammed for a foundation, then 5 inches of base concrete made 7 to 1 and 1-inch surface ½ to 1. The cost this year is nine cents per square foot. They are paid for by debenture, one-half the cost of the property frontage is paid by the owners and the other half and the street intersections paid by the city, where there is a corner lot and a sidewalk on both streets the city pays one-third of the depth of the lot. Cement curbs and combined cement curbs and gutters are paid for in exactly the same manner as the sidewalks. The contract prices for 1904 are as follows:

	Per Lineal Foot.
6-in. cement curb	24½c.
6-in. curb, 15-in. gutter	47½c.
6-in. curb, 18-in. gutter	29½c.
6-in. curb, 24-in. gutter	53½c.

Payment of Pavements.

The city pay the street intersections only, except where a corner lot has a pavement laid on both streets and in such case the city pay one-third of the depth of the lot. Owing to the great width of most of our streets (132 ft.). the cost to the city is about one-third the total cost.

ELECTRICITY AND ACETYLENE.

As noted last month, the first instance on record of the amalgamation of an acetylene lighting plant and an electric lighting plant is furnished at North Bay, Ont., where the North Bay Light, Heat and Power Company, Limited, has taken over the business of the North Bay Gas Company, and the electric plant owned by John Bourke. Extended notice was given in this publication in September concerning the North Bay Gas Company, which sells acetylene for lighting and cooking. The amalgamation was undertaken by A. F. Leggatt, president of the North Bay Gas Company. The new company has a capital of $50,000, and will spend $7,000 in the extension of the gas and electric businesses. The company begins with an income of $14,000 a year and net profits of about $6,000. All of the shares are owned by citizens of North Bay. The directors are: Thomas Wallace, president; John Blanchet, Wm. Martin, Sr.; Sam. Berry, J. T. Lovell, A. F. Leggatt, managing director. The secretary-treasurer is W. Martin, Jr. The company has a perpetual franchise for all kinds of gas and an exclusive franchise for ten years for electricity. The shareholders comprise most of the leading citizens.

UNIONS AND FLANGES: THEIR CONSTRUCTION AND MERITS.*

Union couplings have been in use almost as long as pipe. When pipe was first used, it became necessary to connect the ends in some way, and for this purpose a plain tubular piece of metal was used of larger diameter than the pipe, threaded on the inside so that the threads on the end of the pipe could be screwed into it. This method was satisfactory when new work was put up, and where the end of the pipe was loose so that the coupling could be screwed on to it and the other pipe then screwed into the coupling. This was very objectionable, however, when it became necessary to disconnect any length of pipe, as it was necessary to tear down the whole line to make or repair any part of it. Therefore some one devised the use of the union coupling, consisting of two hubs, each threaded to fit the pipe ends, one end being loose on the nut and the other having an outside thread on which to screw this nut, so that the two ends could be drawn together forming a seat by the connection of the two ends of the coupling, and in this manner making it a joint. It was found, however, that a tight joint could not be made unless some softer material were used between the seats, consequently we have the various forms of union coupling.

Union couplings, and the many forms of their construction, have been and are agitating the public mind and at the present time, this well-known device is the most desirable form for the connecting of pipe ends.

We will, therefore, attempt to discuss their various constructions, with the view to determining the best design. It will be understood that this article is not written with the idea of decrying any make of unions, and we will, therefore, not mention them by name, but that we may fully discuss this matter, and be in a position to judge as to their merits, the writer will attempt to describe them without any partiality, even though his own mind is fully made up as to what he considers the best mode or method of construction.

The first will be the old-style form of union coupling, and will be known as No. 1. The ends of No. 1 are usually malleable iron, as is also the nut, but as we have said before, it was necessary to insert something between the hubs to make a tight joint; therefore, a leather, rubber or even paper washer was inserted between the two hubs, and then the nut drawn tight, binding the two ends together and holding the washer in place. This method was not entirely satisfactory, because this washer would not stand the pressure and wear of the water, steam, air, or whatever the substance flowing through it, owing to its decay or its destruction by the elements with which it came in contact; and also by the fact that the nature of the material prevented the making of a tight joint, it being impossible to obtain a uniform pressure on all parts of the washer due to inaccuracies in pipe alignment.

This method of connecting pipes is used, however, more often than any other because of its cheapness; and price, with some users of material covers a multitude of evils. Some of these are as follows: Constant changing of washers under pressure; loss of same when disconnecting the couplings, and having no others to replace; and lastly, when used on heavy pressure the light weight of the regular coupling necessitates the use of an extra heavy coupling of heavy type at largely increased price.

After a while, we had the brass, or No. 2, union. This was brought out to cover the defects in the malleable iron union and also in connection with the use of brass pipe.

The general construction of this union, aside from its being all brass, was the same as in the former one, except that instead of using a washer to keep the joint tight, the two faces of the union were ground together, thus forming a perfect seat when drawn tight with the nut, and from this we get the name "ground joint union." This method was a great improvement, owing to the fact that the troublesome washer, or packing, was done away with, but there are some objections to its use, viz.: Its increased cost, and when used with iron pipe the difference in the materials of the unions and the pipe ends. This causes trouble, as brass expands much faster than iron, under a temperature, and this causes the hubs to expand and become loose; also because brass, being so much softer than iron, in screwing off or on, in making or breaking joints, the hubs stretch or become so loose on the pipe as to be worthless and have to be thrown away, and thus we have an expensive joint. The ends, or faces, of all brass unions, are supposed to be ground or fitted in pairs, but it is a deplorable fact that a great many of the manufacturers do not do this, because of the expense of this operation. If you will examine the seats of some of these unions, you will find the tool marks on the brass showing no grinding whatever. Thus you fail to get the desired results, namely, ground seats, perfectly tight, but instead, unions forced together, depending on the softness of the metal to make the proper contact.

No. 3 Type—This type is represented by two styles of union, and are what we may call "the soft seat union." The first of them has the malleable iron nuts and ends, but has a flat seat of malleable iron in which is inserted a thin ring of lead or babbitt metal projecting over the seat about 1-16-in. and about ⅛-in. wide. Its chief trouble arises from the fact that this little ring is often abraded before it can be made tight, or is cut by dirt or chips coming in contact with it, defacing or cutting it, and if this is the case, the joints are spoiled, and once the coupling is broken, you have a leaky fitting.

The other style of No. 3 type, instead of one soft seat, has both sides soft, with the same construction of seat as in the ground joint union. This is also liable to destruction through the same causes as the former, and in addition thereto, in making the joint tight, the two seats are mashed together when tightened, and thus, when opening the coupling and replacing upon the pipe, we do not bring these two points exactly together, and consequently have a leaky union.

The next union in use will be known as No. 4, or "Dart Union," but we will defer this description until later, as we desire to discuss some of the others before we take up this.

No. 5 type of union is made with one end entirely of brass, and the other end of malleable iron, with a malleable iron nut. The brass end of the union is the female end, while the iron end is the male. These two ends are supposed to make a perfect joint, and to be so, they must be ground in pairs. Unfortunately, however, we have found a number of these unions showing no attempt to grind in this way. Consequently, we have the same failure to make a perfect joint as in the other union.

Then, too, there are the objections to its construction. On the brass end we have the same trouble as with the brass or No. 2 union, that of unequal expansion and also of stretching. This expansion also takes place between the hub and the nut, often causing trouble. The iron face will corrode or rust and this being the case, we have an imperfect joint. You will often find this union with the iron end covered with oil or grease to prevent its rusting before it is put in use through lying in stock or through lying about a building waiting to be used.

No. 6 type of union has the ends of malleable iron and also the nut, but it has but one brass seat inserted in the malleable iron end. We have here the same trouble of grinding and forcing to a seat, and also the corrosion of the male end, and in addition to this, the hubs are hexagon, and in using a Stilson wrench, which a fitter invariably uses, the sharp ends are torn off when tightened.

If you will compare both of these unions, Nos. 5 and 6, with the No. 4, you will see many points of advantage in favor of the Dart union.

Type No. 7—This is the latest union which it has been the writer's privilege to see. It is all malleable iron, with the exception of the seat. It has two iron faces, male and female, on each of the hubs, into which fits a loose brass washer, thus making four surfaces to constitute a joint. In this manner we see that this union has twice the chances for corrosion that have the two former types, having both sides of the union iron; in addition, the brass washer is liable to be lost or to be jammed in tightening up.

Now that we have fully described all of the makes of patent unions or types of these, we will take up the No. 4, or Dart union. It is constructed with malleable iron hubs and nut, and so built that the wrench will not scar or mar the hubs in screw-

*From a paper prepared for the Association of Steam Engineers.

ing on the pipe. The nut is heavy and strong to draw the parts tightly together for very heavy pressure. This union has been tested in the 1-in. size up to 2,000 lbs.' pressure, while the other makes of unions, unless of the extra heavy pattern, will not stand one-half of this test. The seats of this union are of brass composition, and the male and female ends are absolutely ground in pairs, so that we have a perfect ground seat. The seat is in the shape of a ball and socket, which is the most approved type of joint, and is tight whether the pipe is in or out of alignment. The brass faces are forced, under heavy pressure, into a recess made for them in the hub. They are then turned up true to each other, and then ground to a perfect seat. We see, therefore, that we have all the advantages of the brass ground joint union with the disadvantages eliminated. We have an absolutely tight joint, no corrosion on either end of the face of the seat, and no unequal expansion and contraction of the hub or end and no stretching of the threads in taking off the union. This type of union, therefore, appears to combine all the best features of all the types, and consequently should give the best satisfaction.

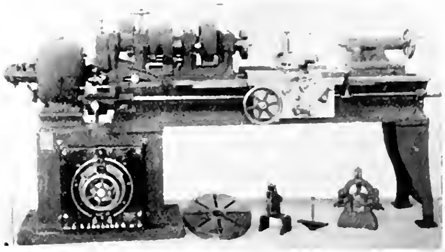
Reasoning from the facts shown, are not two parts, forming the seats of any union, each non-corrosive, better than a seat formed by one part corrosive and the other non-corrosive? And if it is better to have the strength of iron in one end, is it not better when both ends are of iron? If a union made wholly of iron is undesirable on account of rusting, is not a union made with one end of iron liable to the same trouble? If a union made entirely of brass is also undesirable on account of expansion and stretching, is not one made of iron combining the ground joint seat and non-corrosive, much better?

The use of flange unions is not quite as frequent as the union couplings, but in large joints, and in a number of places, union couplings cannot be used to an advantage. Consequently we have the use of the flange joint. As we all know, the flange joint consists of two plates of cast iron, with the hubs of each threaded to correspond with the pipe ends, and with bolt holes on the outside circle of the flange to draw the two parts together. In the flange is inserted any style of packing that may seem desirable to the user of this style of joint. In the first place, it is necessary that the pipes be in perfect alignment to get a perfectly tight flange, and second, it is necessary to draw together the two halves of the flanges exactly equal at all points; otherwise the point that there is least contact on will have a tendency to blow out. Engineers have had so much trouble with blowing out of packing, owing to high temperatures or peculiar conditions, that a number of engineers are sceptical in regard to flange unions except for large size work. After a certain pressure has been reached, it is necessary to use what is known as an extra heavy flange faced and drilled. The flange is the same as the other, except that it is heavier and is trued up so that both sides make a perfect fit; packing is used also in this flange, and the same care must be used in the putting up of the extra heavy type of flange. We will compare both of these types with the Dart patent flange: but first we will state that in addition to packing, all kinds of numerous gaskets of metal, etc., have been devised for the making of tight joints and the preventing of the blowing out of such joints. The Dart flange union is made in sizes from 1½-in. to 12-in. and has practically no competitor or no imitator. The union is constructed in the same manner as the ordinary flange, with the exception that it is heavier and is braced where it receives the bolt, but has in addition the brass ring forced into it the same as in the union coupling. These brass rings are screwed up to match each other, and are then ground, the same as in the union coupling; but you will also note that this flange is tight absolutely in or out of alignment. It makes no difference whether it is bolted perfectly true or not, as the seat is ball and socket, and tight in any position in which you may desire to bolt it. It may be clamped tight at the bottom, and stand open ½-in. at the top, and remain perfectly tight. This flange will stand a pressure of at least 5,000 lbs. without leaking, on an 1½-inch size. Probably the larger sizes, which are made heavier, would stand even more.

The Western Electric Co. is installing light and telephone systems in Red Deer, Alta. The lights are expected to be in operation this month.

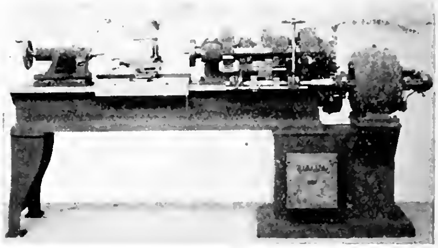
ELECTRICALLY DRIVEN LATHE.

The accompanying illustrations show a front and back view of an electrically driven lathe made by the Lodge & Shipley Machine Tool Co., of Cincinnati, Ohio. The motor is a 2 to 1. The patent head shown gives three changes—the two mechanical



Electrically Driven Lathe—Front View.

changes on the driving shaft make six mechanical changes; this, with the 2 to 1 motor gives a very great range. As ordinarily made, the controller is operated from the carriage, but this arrangement is simpler. This lathe can be furnished with a pulley suitably supported in place of the motor, so that the lathe may be operated directly from the line shaft, with six



Electrically Driven Lathe—Back View.

changes of spindle speed. The makers say: "The great claims we make for this are especially its mechanical simplicity and its neatness of appearance. We also have in this all the benefits of our recently patented lathe head, by which high speeds with heavy cuts, heretofore impossible, are easily obtained."

SIR SANDFORD FLEMING ON CANADIAN RAILWAY ENGINEERS.

The Ottawa correspondent of the Toronto News has obtained a copy of Sir Sandford Fleming's statement before Judge Winchester concerning the employment of United States engineers on the Grand Trunk Pacific, and he writes of it as follows:—

The Grand Trunk Pacific has elected to employ American engineers to locate and build its line. One of these engineers has remarked that "American brains" are needed to make this Canadian enterprise a success. It is not necessary to make a political issue of this line of policy, still less of the rash and ill-informed utterance of an individual. It is not desirable to rush into legislation and enact an anti-engineer alien labour law which will out-Herod the extravagances of American legislation. Rather, an appeal may be addressed to the railway authorities themselves. The best appeal in this case is a recitation of facts. Canadian engineers have been building Canadian railways for forty years, and have done good work. In one notable instance American engineers superseded Canadian engineers, and achieved the most colossal engineering blunder which so far has hampered the progress of Canada.

Sir Sandford Fleming, the dean of the Canadian engineering profession, communicated his views on this subject to Judge Winchester during the recent enquiry. It has proved possible to make public the substance of his state-

ment. Sir Sandford, it may be interjected, in 1863 located the railway line between Toronto and Barrie, and explored the route to Collingwood and Penetanguishene. From 1863 onwards he was chief engineer on the Intercolonial. Later he surveyed a railway in Newfoundland. From 1871 to 1880 he was chief engineer of the National Transcontinental Railway of the day, the Canadian Pacific. It is to be observed that he wrote in terms of compliment of American engineers. "Canada and the United States are very near to each other, and they have many ties. We are on friendly relations with our neighbours, and give cordial welcome and employment in Canada to citizens of that country, or, indeed, skilled aliens from any land. We are the gainers eventually if they can teach us anything we do not know, or if they can do anything better than ourselves. All are placed much on the same footing as our own people. If aliens cannot do better work there is no justification for them receiving better pay and a preference to Canadians."

Sir Sandford Fleming's experience of Canadian engineers has been favorable: "All the engineers under me on the Intercolonial, the Newfoundland and the Canadian Pacific Railway explorations, location surveys, or construction were Canadian. Some were born in the United Kingdom, but all were British subjects, and all were residents in Canada or in some portion of British North America when they were engaged. Such engineers were quite equal in ability, and, generally speaking, were fully as capable in the performance of their duties as any engineers from the United States whom I have known. No difficulty was experienced in securing Canadian engineering talent forty years ago for the Intercolonial Railway, and since then for the Canadian Pacific Railway. A large number of men have gained good experience on these and other lines. The Military College at Kingston and the Canadian universities have long been training young men for engineering work, and many of them have for years been employed on the survey and construction of railways and other work, and are now quite ready to fill similar positions. I am perfectly satisfied that we have to-day in Canada an ample number of skilled men to carry on and complete the new national railway."

The work done by these Canadian engineers was excellent. Their chief was years ahead of his time as preacher of the need of easy gradient. In his report of 1879—twenty-five years ago—he used the following language: "The gradients and alignments of a railway have much to do with its capacity for business, and the cost of working it. It is well known that by attention to these features in locating a line, it is quite possible, in some cases, to double the transporting capacity of a railway, and very largely reduce the cost of conveying freight over it." As a result of his care, the eastward grades, between Winnipeg and Fort William, do not exceed 26 feet in the mile, or one-half of one per cent. The Intercolonial is a very carefully constructed railway, far superior to the Canadian Pacific Short Line to St. John. Mr. Blair a year ago gave a noteworthy example of the substantial advantages which the Government railway possesses. So, too, in the western portion of the Canadian Pacific the Canadian engineers did good work.

In sheer exploration the Canadian work was monumental. "At the beginning of the surveying operations in 1871 there was very little known respecting the country from the River Ottawa to the Pacific, comprising fifty or sixty degrees of longitude. At that period it was a prevailing belief that the construction of a continuous railway through it from ocean to ocean without crossing over to the United States was impracticable; indeed, it was so declared in emphatic terms by the highest known scientific authority of the day. The laborers of the Canadian engineering expeditions, however, set at rest all such views, and cleared away all pessimistic beliefs. Through their labors the vast territory ceased to be a terra incognita, the surveyors with their instruments of precision pierced the formidable barriers imposed by nature, and by such means solved every problem of practicability."

We are all talking to-day about the fertility of the Saskatchewan valley, about the splendid natural resources of Edmonton, and about the importance of easy grades. The Canadian engineers, working under Mr. Mackenzie's Government, and employed on strictly Governmental work located a line for the Canadian Pacific which ran diagonally from Winnipeg to Edmonton, traversing the richest part of the North-West. They found through the Yellowhead Pass a splendid route, with easy and uniform grades. In 1880, however, the Canadian Chief Engineer was displaced. American engineers were called in. The road east of Winnipeg and west of Kamloops was already under construction, but in the prairie and Rocky Mountain sections they changed the plans formed by the Canadian engineer.

Two remarkable results followed. In the prairie, the rich Saskatchewan valley was abandoned, and the line was sent due west through the arid country. To-day, the Canadian Pacific as it spends its three millions in irrigation work possibly regrets its refusal to possess the "fertile belt." Possibly, also, Messrs. Mackenzie & Mann and the Grand Trunk Pacific, as they follow the Fleming route of thirty years ago, feel thankful to the American engineers who chose to go by way of Calgary.

Secondly, the American engineers of the Canadian Pacific abandoned the Yellowhead Pass and drove a line through the Rocky Mountains by the Kicking Horse and Rogers' Passes. In doing so they incurred great risks. It is a fact, recently brought to light, that the rails were laid to Calgary before the railway company had any assurance that a practicable route existed through the mountains opposite. When the road was built, it saved 45 miles in mere length, reducing the length from Montreal to Vancouver from 2,947 to 2,902 miles, at a cost of grades which are a permanent and irremovable obstacle to the success of the line as a freight route.

A diagram compiled not long ago by the late Marcus Smith, formerly assistant engineer to Sir Sandford Fleming, shows the profile of the Yellowhead Pass route located by Sir Sandford Fleming. Its highest point is 3,718 feet, and that involves a rise of only 1,210 feet. The rise to and descent from that summit are gradual. The Kicking Horse Pass route chosen by the American engineers has two summits, one of 5,330, the other of 4,344 feet; between them the line falls to a point only 2,458 feet high, a drop of 2,872 feet and a rise of 1,886 feet. As the Canadian Northern and the Grand Trunk Railways take the entire routes through the Yellowhead and still more northerly passes, they may again thank the men who diverted their competitor to the steep gradients of the Kicking Horse Pass.

Sir Sandford Fleming's conclusion is not unnatural. "I am firm in the conviction that the United States railway engineers have no qualifications superior to the qualifications of Canadian engineers, and that the Canadian engineers have special qualifications and methods for doing effective work under Canadian conditions which are not possessed in the same degree by alien engineers, whose training and experience have been gained under different conditions." He went on in this connection to urge strongly the employment of Canadians, if only because they would have their hearts in a work which means everything to the future of Canada. "I trust," he wrote to Judge Winchester, "that I have made it plain in the matter of the proposed undertaking, that there is great risk in placing it in the hands of men whose characters are unknown, that there is especial danger in employing alien engineers, who, for aught we know, may come under the influence of those who would profit most by the non-success of the Canadian line."

GAS ENGINE PROGRESS.

Editor Canadian Engineer

Sir,—The gas engine for the past five years has had a very steady and strong growth in general use.

It has reached a stage near perfection, for example: a 7½-h.p. engine has only about 5 or 6 pieces in the whole entire engine, it has no valves, no springs, no complications except for 2 or 3 small batteries for the sparking device. Four or five gallons of water for the purpose of cooling the cylinder, and has nearly a perfect balance in its construction for its vibration. It is one of the most independent powers that any man might purchase.

A French type of engine that will be made in Canada at an early date can be used for automobiles, yachts, direct connection of dynamos for lighting, etc., running pumps in place of wind mills, running centrifugal pumps for mining purposes, for general farm work, threshing and several other purposes. A 10 or 12-h.p. engine will weigh in the neighborhood of about 300 lbs. Gas engine plants can be installed for one-half of an electric plant, and 25 per cent. of a steam plant.

Respectfully yours,
F. C. BROOKS.

Niagara Falls, Ont.

DEVICE FOR PREVENTING EXPLOSIONS OF GASOLINE AND OTHER INFLAMMABLE LIQUIDS.

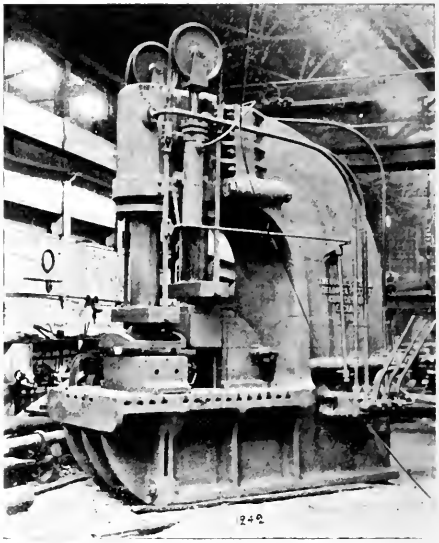
An invention in Birmingham, England, called "nonex," is a device for preventing the explosion of receptacles containing highly inflammable liquids like gasoline, benzine, etc., which give off explosive gases. It is an application of the principle of the Humphrey Davy safety lamp used in gaseous mines, supplemented by a fusible cap or plug. If a vessel of ordinary type containing an explosive liquid be subjected to sufficient outside heat, or if the contents be lighted at the orifice, the walls of the tank will burst by the force of the expansion. At an exhibition given by the Non-Explosive Device Company, a 20-gallon tank was partly filled with gasoline and placed upon a lighted bonfire. The fusible screw cap, made in two parts, which were simply soldered together, soon blew out, the solder having melted, and the ascending vapor caught fire immediately; but no explosion followed, because the orifice of the tank formed the upper end of a tube which projected down inside the vessel to its bottom, where it was closed. To allow the oil or gas to percolate from the interior of the tank each of the metal layers of which this tube was composed had been perforated, and, while the perforations would permit the spirit to be poured out, they prevented the passage of the burning gas to the interior by absorbing its heat as the wire gauze does in the Davy lamp. While the gasoline contained in the tube burned, the flame did not extend to the liquid or accumulated vapor in the half-full tank. The flame was easily extinguished with a bundle of rags and then lighted and put out several times. A motor car tank to which the device was affixed was lighted with a match and extinguished at will. A gasoline can without the device exploded almost instantaneously when lighted.

HYDRAULIC FLANGER.

Fielding & Platt, of Gloucester, England, who have equipped the majority of the leading locomotive and engineering shops of the world, have supplied the Hydraulic Steel Flanger, here illustrated, to the Locomotive and Machine Company, of Montreal.

This machine has a gap of 4 feet, and an opening of 5 feet, the total power exerted by the two vertical rams 100 tons (112 short tons), and by the horizontal rams 50 tons (56 short tons), generally as described below. The main frame is of cast iron of box section, amply strong and rigid, fitted with horizontal ram for flattening ends of plates. The frame is planed to receive cylinders which are secured by a pair of strong steel turned bolts fitting in bored holes. There are two vertical rams of cast iron, turned and polished and fitted with hemp packing, also one horizontal ram, the cylinder being gunmetal lined. The drawback cylinders are bolted to main cylinders and connected to the main rams by means of flat steel wire ropes passing over equalizing pulleys as shown, the cylinders being of cast iron, with cast iron rams turned and polished, and fitted with glands for hemp packing. The horizontal ram is fitted with direct piston drawback formed in cylinder cover. The operating valves are of Fielding's patent piston type, with gunmetal bushes and fittings. These valves to be designed to ensure ease of working, easy removal and renewal of same, having extra large area of water-ways. The machine is fitted with one set of blocks for sectional flanging circular plates, consisting of bottom block, with two curves of different radii; one vice block fitted with vertical ram; one flanging block fitted to rear vertical ram; one planed angle guide bracket for guiding flanging and horizontal rams; one horizontal ram extension piece and squaring uptool.

A crane was also supplied by Fielding & Platt, for lifting the plates into position in connection with this Hydraulic Flanger. It was designed for lifting 5 gross tons through a height of 5 feet, and with a rake of 20 feet, being to the following specification. The post and jib are of steel of I section, and the tee bars of steel. Contained between the posts is a cylinder of cast iron, bored out for ram with hemp packing, the cylinder also supports the jib, turned steel shafts are carried in bosses on the cylinder which carry rollers that guide the cylinder, and brackets with gudgeons



Hydraulic Flanger.

are fitted in top and bottom of post to support the crane, pressure is admitted through the ram, a carriage or jib with rollers and swivelling hook are provided, as shown. The working valve to be placed on the Hydraulic Flanging Press that this crane would serve.

The Canadian representatives of this company are Peacock Brothers, Canada Life Building, Montreal, who have been pioneers in the introduction in later years of British machinery, having imported the large majority of the heavy British machines brought here in the last six years for mining and general engineering purposes.

MACHINE SHOP NOTES FROM THE STATES.

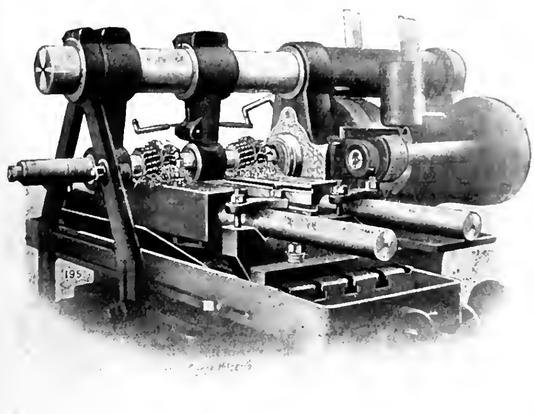
By Chas. S. Gingrich, M.E.

IX.

One of the most tedious and most expensive pieces of work that are met with in manufacturing woodworking machinery is squaring and grooving the steel cutter heads to which the cutters of rotary wood planers are secured. For years it has been the custom to turn up the journals, and then work the body of the piece down square to the correct shape on a planer. These pieces are made of high carbon steel in order that the journals may be durable at the high speed at which they must work; consequently the machining process is a very slow one, particularly slow because of the accuracy required in order that the edge of each of the four cutters which each piece carries will be on a radial line and exactly the same distance from the centre of the piece.

The extensive use of the milling machine has simplified

this job quite considerably, and the accompanying illustration shows a method recently adopted by the J. A. Fay & Egan Co., Cincinnati, Ohio. They fasten two of these pieces to the table of a No. 4 Plain Cincinnati Miller, and finish one side of each of the pieces at a single cut. The bars are



4½ in. in the rough, and the cut is ¼ in. deep, added to which are the grooves, one of which is ⅞ in. deep and 21-32 in. wide. The cutters are made of Novo steel, and are 4 in. and 5¾ in. in diameter. The work is fed through the machine 15-16 in. per minute, and the finished surfaces are smooth and accurate.

The municipality of Kildonan has arranged terms with the Winnipeg Street Railway Co. for the extension of the electric railway from the city to Bird's Hill via Norwood bridge. The company is to get exemption from taxation for twenty years and a franchise—but not an exclusive one—for thirty-five years. Two miles of the road are to be built the first year, operations to be commenced in the spring.

HIGH SPEED STEELS.

Changes in Machine Tool Design.

C. H. BENJAMIN, IN CASSIER'S MAGAZINE.

It has been interesting to watch the changes brought about in the designs of machine tools, as a result of the keen competition in manufacturing and the demand for a greater output per machine. Such a thing as running a lathe or a planer to the limit, even of its former capacity, was once a novelty. For the most part these machines jogged along in a comfortable and contented fashion with the operator also comfortable and contented.

The introduction of the new process steels for tools is a result rather than a cause of the recent awakening and of the endeavor to get out of each machine all that there is in it. Many of the tools built ten or twenty years ago were incapable of getting the best work or the limiting quantity from even the ordinary carbon tool-steels. The belt would slip, the gears would break and the frames and spindles would spring.

Of late, however, machines weigh more, have wider belts, bearings of greater surface, and can stand up to the work required of them. But now comes the high-speed steel and there is more trouble. Not only must the machine have stronger parts, but it must have more power to turn the spindle and to push the carriage. To understand this, it is only necessary to make a few comparisons.

Formerly the lathes, planers, shapers and other tools in an ordinary machine shop consumed from half a horse-power to two horse-each. The writer has seen a 16-inch lathe stalled when doing less than one horse-power.

Recent tests with a lathe of 20 inches swing, turning soft steel, have shown a gross horse-power of [illegible] seven to sixteen with one maximum reading of over thirty horse-power. The manufacturer of one well-known turret lathe recently told the writer that a new machine now building for use with high-speed steels would consume twelve horse-power. This will be more easily understood when we consider the enormous amount of metal removed by some of the new machines.

One lathe, when turning soft steel at a speed of 125 feet per minute, removed metal at the rate of 625 cubic inches per minute or about 1,000 pounds per hour. Another lathe, running three tools, cut steel with a speed of 50 feet per minute at the rate of 113 cubic inches per minute or about 1,900 pounds per hour.

A prominent firm making slab milling machines guarantee the removal of 210 cubic inches of cast iron per minute, or about 3,200 pounds per hour.

Now reliable tests of machines in actual service show a consumption of power per pound of metal per hour of 0.03 to 0.07 horse-power under favorable conditions, exclusive of the power required to run the machine itself. Using the smaller value, or 0.03 horse-power, gives the power required in these three instances as 30, 57, and 96 horse-power, respectively.

The cases cited are, of course, extreme ones and examples of what may be called "slaughtering stock," but they nevertheless show what these machines are capable of doing. The rapid reduction lathes, as they are sometimes called, present several points of difference from their immediate predecessors. The steps of the driving cone are fewer in number and have faces suitable for wide belts, sometimes four and sometimes even six inches wide. The speed of the belt is also increased, for it is an axiom that the power of a machine must be measured by the belt and not by the gearing. No complication of double or triple gearing will give power to a lathe which has a narrow, sluggish belt.

Cut spur gears are now used wherever necessary and gear boxes have taken the place of speed cones for controlling the travel of the tool. The mechanism inside the apron has received particular attention, for this is the weak point of many lathes. The use of steel gears and racks and of double bearings for the pinions has remedied this defect.

The tool-post has been strengthened, the head and tail spindles have been enlarged and all the bearings are made wider and longer. Some of these lathes are now capable of melting the points from the new steel tools.

It is rather remarkable that the principal advantage in using high-speed steel has appeared in the turning of wrought iron and mild steel, and that cast iron still remains obdurate. While it is no uncommon thing to-day to see soft steel turned at speed varying from 125 to 250 feet per minute, a speed of over 50 to 60 feet per minute for cast iron is unusual. The peculiar granular character of the casting or perhaps the presence of graphite is fatal to the life of the tool point at high speeds.

Planing machines have not profited by high speeds as have the lathes, probably on account of the intermittent character of the work. Sixty feet per minute is about the highest recorded speed, and this is not recommended for ordinary planing. A cutting speed of 35 feet per minute with a return of two to one is as high as can be economically used. A common mistake which has been made is to increase the return at the same rate as the cutting speed. This is apt to make trouble at the end of the return stroke.

The possibility of doubling the cutting speed without changing the return is excuse enough for the use of the new steel. A good arrangement adopted by our planing machine builder company is to vary the cutting speed from 20 to 40 feet per minute by gears and to keep a constant return of 72 feet per minute.

The power required for reversing a planing machine is so much greater than that ordinarily used in cutting metal that an increase in the latter, due to the use of high-speed steels, has not materially affected the driving power required. What is generally needed is not so much power as flywheel effect.

Some rather remarkable records have lately been made with twist drills of the new steel, but in Great Britain, rather than in America.

The cutting speed of the lip of an ordinary carbon-steel

drill has usually been from 25 to 35 feet per minute. With the new drills these speeds have been more than doubled, with compounding increase of the feed and an even greater difference in the total number of inches drilled. This means a stiffer machine, more belt power, and the use of positively geared feeds.

The milling machine is beginning to feel the new influence, and both speeds and feeds are being increased, more particularly the latter. A feed of two or three inches per minute used to be considered good practice. To-day ten or even fifteen inches per minute are not excessive for the travel of the table.

Experience has shown that increasing the feed is more profitable than speeding up the cutter. The principal changes that are noticeable as a result of the new practice are a strengthening and stiffening of the support for the cutter arbor and a substitution of geared for belted feed motions.

It is to be noted, however, that the increase in power required with the new steels is not so great as the increase in output secured. There are numerous instances where the work done has been more than doubled., while the power increase required has not been more than 50 per cent. The average consumption of power by carbon steels is usually 0.05 or 0.06 horse-power per pound of metal removed per hour, and the new steel will require only 0.03 or 0.04 horse-power.

The increasing use of electric motors is, or should be, a factor in the development of machine design. Except in a very few instances, however, little modification has been made in adapting machine tools to the new motive power. In most cases the change has meant a bracket cast or bolted to some convenient part of the frame and the connection of the motor by belt, gears or chain to the driving mechanism; in other words, merely substituting the motor for a countershaft.

At the present time there is no standard type of motor for such service, and most tool builders are advertising their willingness to adapt their machines in a tentative way to whatever motor the customer may elect.

In many shops the group system of driving is the more economical, and no modifications of the machines themselves are necessary. But even when its independent drive is decided upon, there is no unanimity of opinion as to how it shall be arranged. Some prefer the variable speed motor with a controller, some the smaller constant-speed motor with mechanical speed control, and some a combination of the two.

One designer uses belts, another gearing, and a third the silent chain; in fact, most builders advertise all three, leaving the burden of choice upon the buyer. Perhaps the general consensus of opinion is in favor of the constant-speed motor, as it is smaller and cheaper and can be run at a high speed.

On large machines, where a considerable range of speeds is economical, a combination of the two systems is desirable, using perhaps four to six speeds on the controller and multiplying these by the usual gearing. Some large lathes and boring mills have as many as 72 speeds obtained in this way.

It is evident to the unprejudiced observer, as he studies the various arrangements of motor drives shown in catalogues, that the machine tool builder and the electrician have not "got together" on this problem, and that in most instances the machine has not been adapted to the motor or the motor to the machine. There is some excuse for this in the fact that most manufacturers of machine tools build certain standard machines, which are to be sold to the trade and are to be driven, some in the old and some in the new way, and must consequently be adapted to either set of conditions.

The rapidly increasing use of electricity as a motive power will change all this, and every year more machines will be built for electric drives alone. We shall then see machine tools in which the motors will be an integral part of the design and the present loose and temporary relations will be replaced by a definite and permanent connection.

The Structure of High-Speed Steels.

THE ENGINEER, LONDON.

Although high-speed steels have sprung into popularity with surprising suddenness; although much has been written about their use and something about their manufacture, little has been heard as to the causes which give them their astonishing properties. We turn, therefore, with no small amount of interest to two papers which appear in the current "Bulletin de la Société d'Encouragement pour l'Industrie Nationale," one by Le Chatelier and the other by Osmond, which promise us some light on this subject. These gentlemen hold such an exalted position in the field of scientific metallurgy that we must give close attention to whatever they have to tell us.

It is, then, disappointing to find that the explanations they offer are only tentative, and, in Osmond's case, not even based on actual commercial high-speed steel, which he has not examined, but only on specimens of chrome and tungsten steels, which he assumes to possess the same nature. We are far from saying that he is not right in this assumption, since we can ask for no more capable judge of such matters; but it is impossible, when we remember the remarkable effect that minute quantities of certain ingredients have on alloys, not to regret that the examinations on which his theory is founded are not based on actual samples of such metals as are used daily in manufacturing works. However, leaving that to one side, the explanation Osmond has to offer is simple and up to a certain point convincing. No new theory he tells us is required, only a slight addition to that of the hardening of ordinary carbon steel. "To render the general theory of carbon steels immediately applicable, it is sufficient to take account of the fact that the separation of carbide during cooling and its corresponding solution during heating are rendered difficult by the presence of chromium, tungsten, or other substances." Hence the changes in the constitution take place slowly, and we need not adopt such a sudden method of arresting them at any particular stage as when we plunge ordinary carbon steel into water. It is sufficient to cool the tungsten steel slowly to obtain the same end. Put in another way, whereas we must use powder and shot to stop the hare, we may roll a ball fast enough to strike the tortoise. If such an explanation as this on further examination should be proved to hold good, it is entirely admirable for its simplicity. It, too, may be taken to explain the extraordinary fact that such steels cut well at temperatures which would soften ordinary tool steels. The reason the latter fail is that at the temperature reached the particular condition obtaining at the instant they were petrified by being suddenly chilled is destroyed; but with tungsten steels the brakes, so to speak, are hard on all the time. The change takes place slowly instead of rapidly, and, in place of the rapid softening at the edge which occurs with ordinary steel, a comparatively long period of subjection to the high temperature is necessary. This, combined with the fact that the changes do not occur until a fairly elevated temperature has been reached, gives us an explanation of why high-speed steels will cut at a dark red heat. Le Chatelier tells us that such steels will stand 500° to 600° C., "at least for a certain time," and that it requires the application of 700° for an hour to soften them completely. We may add to this that Osmond seems disposed to accept a suggestion of Le Chatelier's that the high temperature that must be reached to restore the qualities of tungsten steels is due to the fact that at this point "austenite transforms itself into martensite," and that hardening takes place instead of the softening to which one is habituated by ordinary carbon steels—a suggestive, if not a very satisfactory, explanation of their peculiar cutting properties.

Whilst Osmond has little or nothing to say about practical applications, Le Chatelier gives more attention to them than to questions of constitution. He urges, very rightly, a point which we believe has been thoroughly well grasped in this country, and which is testified to by the extraordinary success of British high-speed steels. It is, of course, the necessity for exactness, in manufacture—exactness in the apportionment of the ingredients and precision in the temperatures used in treatment, but he makes the curious reflection on the ease with which self-hardening steels are treated that it rather hinders progress, since that delicacy of manipulation, which he believes will some day be required when the highest duty is sought, is not now demanded. That is a point of view that will certainly not

appeal to foremen and managers whose objection to the Taylor-White steel was that it could not be treated in their own shops, and whose preference for our English steels is that one may do pretty well what he wills with them, from not treating them at all to treating them badly, and they will still behave at least fairly well. We have ourselves subjected a well-known brand to such various tests as cooling in air, cooling in a blast, plunging in water from a high temperature, and hardening in oil, and it has not injured it, and we have taken a piece of the same steel from the centre of a square bar some six feet or seven feet long, ground it to an angle, and used without treatment at all; we have tried it wet and dry, and nearly red hot, and got equal results from it, and we think nearly all managers would agree with us that the ideal, from their point of view, is a steel of this order that they can hardly destroy by any treatment, and that can be used for any purpose. The former condition is nearly reached—the steel is not necessarily destroyed by bad treatment, but its highest results are not attained—but the latter is still far from attainment since no single steel is equally good for cast iron and steel. No brand, we believe we are right in saying, possibly with the exception of some drills, will do equally well on a casting as on a forging, on brittle cast iron as on ductile steel. That is a curious fact that would demand closer attention, if it were not that brands particularly suitable for each purpose are readily obtained.

The Practical Working of High-Speed Steels.

THOMAS BEASLEY, IN MODERN MACHINERY

Since the introduction of high-speed steels there has been a great deal written and published on the subject, as there should be, for the discovery of this important adjunct to modern machine tools was a most important event, especially where mild steel of all descriptions, good, bad and indifferent, is used in so many different branches of trade as it is to-day, and seemingly crowding out iron, where formerly it was thought nothing else could be used for the purpose.

When mushet steel came on the market it was hailed with delight as the ideal tool for all purposes. It was a step far in advance of anything then thought of, but while for some purposes it is still good, it has practically lost its usefulness since the introduction of the "Blue Chip," "Air Novo" and other steels in this class.

The great trouble with mushet steel, when in operation, was the liability to burn and chip off and the extreme care required by the smith in working over worn-out tools or making new ones; also the great difference in hardness and ductility of different bars that came in the same shipment. I have not as yet found any such difference in either Blue Chip or Novo steel, and as far as the working in the fire is concerned, one piece works the same as the other and seemingly gives the same results when in operation.

I have done considerable experimenting in heating and working the above-mentioned steels, seemingly to good advantage, the results obtained being very satisfactory. As our high-speed tools have to cut and machine rails on switch and frog work, we encounter some tough customers at times, while on other jobs the cutting is as soft as would be the case with wrought iron. Such a varied class of work necessitates the very extreme of hardness, and while I had some difficulty for a time I finally obtained the desired hardness.

I found that the heating played an important part in this result. When the steel was heated rapidly up to a high heat the edge would not hold, but when heated to a white heat at a slow blast and then given a quick blast until it was as hot as it was possible to get it, the result was always satisfactory. The means I made use of to harden for extreme hardness was to heat the steel as hot as possible, dip the point in oil (linseed) just far enough back to cool quickly, and when the portion in the oil turned black I would transfer quickly to the air blast to cool. Where I had quenched the point entirely in the oil the heat was not always entirely the same through the tool (especially heavy ones like we use, $1\frac{1}{2} \times 2$ inches), consequently, when this was the case, they would crack and be useless in service, until I hit upon the expedient of dipping only the portion that was the hottest and of the same temperature. Transferring to the air blast keeps the tool from drawing the hard point after the oil dip. It is necessary to be careful to use plenty of fuel and get as short heat on the tool as possible.

Probably the average machinist does not hail the introduction of this steel with the appreciation it deserves, simply because the machine does far more work in a given time than with tool or mushet steels, but speaking for the tool-smiths in general, nothing gave them more satisfaction than the banishment of mushet steel, for one could never put any dependence on the outcome when working over a mushet tool. Heat it and work it as you would, in many cases a failure was sure to be your reward; but with the advent of the new steel came the following instructions:

Heat it slowly, but heat it to a bright yellow, and you will find that you can forge it with a sledge or steam hammer; bend it, cut it, gouge it, in fact, do anything but break it, as long as the heat does not fall below a cherry red. Don't forge or work it below this heat, as this is the weak point and you will do the tool an injury; but the many good points will surely compensate for this one weak one.

Some smiths are foolish enough to believe that they stand in constant danger of overheating this steel if made too hot, but from my observations and practical experiments I find that it is out of the question to burn it or destroy the quality in an ordinary forge fire. While it is true that if heated too quickly the corners will waste slightly, the centre will stand intact after the fiercest heat. I once took a piece of this steel which had been forged from $1\frac{1}{2} \times 2$ inches, to $\frac{3}{4}$ inch square, and heated as far as I possibly could, but this seemed to improve the durability and heat-resisting qualities. I made a drill from this same piece (Air Novo) and it drilled a hole through a hard gray casting at the highest speed at which the press could be run and showed no ill effects, burning or blunting of the cutting edge. Borax had no effect on this piece as it has on ordinary tool steel, for it laid on this steel like dust after the fire melting it; my efforts to weld it to a piece of iron with a V weld were futile. It is not weldable with borax for a flux.

This steel can be annealed by muffling in dry ashes, lime or charcoal dust. The latter gives the best results, but with it the steel is never soft enough to machine. If the edge will not stand and it seems to have lost its hardness, as all steels of this description will at times, have some leather scraps in a box or can (a double handful or more), heat your steel to a good yellow on the cutting point and cover the hot point with the leather scraps and allow to cool in this position. Repeat this process about four times and the tool will be restored.

In conclusion I will say that I think the usefulness and the varieties of purposes to which these steels can be put have not been fully tested as yet, and if they can ever be improved so that they can be machined, as tool steel can, and the cost placed within reason, the steel for all purposes will surely have been found. The ease with which it can be forged is the redeeming feature, and with a smith who is a close worker many tools can be fashioned close enough to dispense with the machining and be trued up on the emery wheel instead.

S.P.S. ANNUAL OUTING.

On Saturday, October 22nd, the School of Practical Science of Toronto University held their annual outing, this time going to Niagara Falls. A special Grand Trunk train carried the party, which numbered nearly 350, on such a time table that nearly twelve hours were available for sight-seeing. The morning was spent going over the works of the power companies on the Canadian side, where the party was met by representatives of the different companies, who explained the works under construction. In the afternoon the students broke up into four parties. One made further investigation on the ground covered in the morning; a second examined the construction of bridges; a third went down to Queenston, ex-

amining the geology of the region; while a fourth crossed the river and went through various plants in Niagara Falls, N.Y., including the Niagara Power Co., the Hydraulic Power Co., and the International Paper Co.

The committee having in hand the arrangements for the day were: Prof. C. H. C. Wright, E. A. James, C. H. Shirriff, Frank Barber, and J. E. Caldwell. These gentlemen are to be congratulated on the excellent programme which they arranged, and the splendid way in which it was carried out.

CATALOGUES RECEIVED.

The following catalogues have been received by the Canadian Engineer and may be obtained by mentioning this Journal:

Graham, Morton & Co., Limited, engineers and contractors, Hunslet, Leeds, Eng. Souvenir booklet containing photographs showing rapid construction of this firm's new engineering works, and a description of the same.

Kellogg Switchboard and Supply Co., Chicago. "Magneto Switchboards," a neat and well illustrated descriptive booklet of 100 pages.

John Morrow Machine Screw Co., Limited, Ingersoll, Ont. Revised catalogue of standard and special screws, etc.

August Mietz, New York. Catalogue of Mietz & Weiss gas and oil engines.

National Electric Co., Milwaukee. Bulletin 350, descriptive of air compressors for continuous and intermittent service.

Yale & Towne Mfg. Co., New York. Circulars descriptive of chain block exhibits at St. Louis Fair.

Joseph Dixon Crucible Co., Jersey City, N.J. Pamphlets, "Graphite as a Lubricant," "Oil vs. Grease," and "Dixon's Graphite Cup Greases."

Elmer P. Morris Co., New York. Catalogue of tubular poles and brackets for electric railways, lighting, telegraph, etc.

Sheldon & Sheldon, Galt, Ont. Bulletin 21, Hot Blast Heating Apparatus; also pamphlet descriptive of special fans designed for asbestus mines.

Browning Engineering Co., Cleveland, O. Catalogues of locomotive cranes.

Canadian Westinghouse Co., Hamilton. Circular 1,088, generators for three-wire direct current service.

Westinghouse Electric and Mfg. Co., Pittsburg, Pa. Circular 1,092, descriptive of multiple alternating arc lamp.

Sterling Electric Co., Lafayette, Ind. Catalogue of telephones and apparatus.

A. Leschen & Sons Rope Co., St. Louis, Mo. Illustrated booklet, "Wire Rope Tramways."

Jenckes Machine Co., Limited, Sherbrooke, Que. Booklet on Gold and Silver Milling. Bulletin 1,100.

Spaulding Print Paper Co., Boston, Mass. Circular about the Federal blue-printing machine, a continuous printing apparatus for making blue-prints by electric light.

Crane Co., Chicago. Special catalogue No. 100, pop safety valves, etc. Also folder illustrating globe and angle valves.

Allis-Chalmers Co., Milwaukee. "The Book of the Four Powers" is a very attractive and well-printed booklet describing in a connected way the products of the company in the realms of steam, gas, water, and electricity.

Pratt & Whitney Co., Hartford, Conn. Catalogue of small tools, with reference tables.

Niles-Bement-Pond Co., New York. "Horizontal Boring, Drilling and Milling Machines," illustrating the machines and the same at work.

Trussed Concrete Steel Co., Detroit, "Facts concerning the Kahn Trussed Bar," a booklet containing nearly 50 photographs of concrete constructions, and also of tests of the Kahn Bar.

Jeffrey Mfg. Co., Columbus, Ohio. Catalogue of Jeffrey "Century" rubber belt conveyors, also booklet illustrating grab buckets made by the same firm.

Norton Grinding Co., Worcester, Mass. Catalogue of plain cylindrical grinding machines for straight and taper work.

Waterous Engine Works Co., Brantford. Catalogue of the McEwen high speed automatic engine, with detailed description of construction.

Laidlaw-Dunn-Gordon Co., Cincinnati, Ohio. Bulletin L 601, catalogue of Meyer-gear pumping engines.

Hardie-Thompson Co., 110 Cannon St., London. Pamphlet, describing the Hardie-Thompson water-tube boiler, just being introduced on the market, the novel feature of which is independent water circulation in each tube.

Cunliffe & Croom, Ltd., Manchester. Brass Finishers' Machine Tools. An illustrated sheet giving list supplementary to catalogue.

Fairbanks Co., Toronto, Montreal, etc. Price list of Fairbanks Wood Split Pulleys.

Canadian General Electric Co., Toronto. Booklet, "Some Facts regarding Type H Transformers."

Garvin Machine Co., New York. "Special Machinery," a booklet containing condensed descriptions and reduced illustrations of over 100 special machines.

Newall Engineering Co., Warrington, Eng. Catalogue of measuring machines, micrometers, surface plates and other workshop gauges.

Smooth-On Mfg. Co., Jersey City, N.J. One hundred page catalogue of products of this company.

Canadian Rand Drill Co., Montreal. Coal Cutter catalogue. From the same company we have received a post-card cut in the shape of a compressed-air riveter, illustrating the latest "Imperial" tool.

Jenkins Bros., New York. Booklet entitled "Valve Troubles and How to Avoid Them." Besides suggestions such as indicated by the title, the book contains descriptions and illustrations of Jenkins' valves.

Diamond Saw & Stamping Works, Buffalo. A neat folding card containing price-list of Sterling Hack Saws.

Penn-Allen Portland Cement Co., Allentown, Pa. Booklet containing description of works, analyses of cement and testimonials of users.

North-West Machinery & Iron Co., Winnipeg. One hundred page catalogue of blacksmiths' and carriage-makers' tools and supplies.

Office Specialty Mfg. Co., Toronto. Folder, showing range of goods made by this company.

LITERARY NOTES.

The Street Railway Journal published a 360-page special number on October 8th, celebrating the completion of its twentieth year of publication. The number is taken up largely with historical articles. The development of street railways during the past twenty years, viewed from various aspects, is dealt with by contributors who are specialists in their respective lines. Interest for Canadian readers attaches to an article on "Electric Railway Work in America Prior to 1888," in which is described and illustrated the railway operated at Toronto Exhibition in 1884 and 1885, one of the earliest lines on the continent. Regular features of the journal are not neglected in this special number, and altogether it is an issue of great attractiveness and value.

Aluminothermics is the title of a lecture delivered by Dr. Hans Goldschmidt, of Essen-Ruhr, Germany, at McGill University, Montreal, on October 7th. The introduction of coal as fuel, and later the discovery of a new fire, the electric arc, have marked the onward strides of civilization. And now comes a new heat-producer—the use of aluminum by the thermit process. By this method great heat is obtained with a speed unattainable by any other process—5,400 deg. F. is reached in about one minute. The lecture explains the chemical reaction, and deals with many applications of the process, which were also explained at some length in the August number of the Canadian Engineer. Wm. Abbott, 334 St. James St.,

Montreal, is Dr. Goldschmidt's agent in Canada, from whom copies of the lecture may be had.

The Montreal Electrical Handbook is a neat book of 200 pages, descriptive of Montreal from the electrical standpoint, It is one of a series of ten books published in connection with the trip of the foreign delegates to the International and Electrical Congress in St. Louis, in September last. Though there was very little time in which to prepare the book, the articles are well written, and the whole is splendidly printed and illustrated. The articles are written by different contributors, each one an authority, and include a brief history of Montreal and district, and accounts of all the large electrical enterprises in that city, together with descriptions of Ottawa and of the Niagara region. The book is published under the auspices of the American Institute of Electrical Engineers.

The Michigan College of Mines Year Book, 1903-04, with announcement of courses for 1904-05, contains, besides information such as would be expected in such a publication, valuable maps of mine districts in northern Michigan. A list of graduates is also issued, giving present locations of alumni and information as to their employments since graduation. The college is at Houghton, Mich.

The University of Illinois engineering experiment station at Urbana, Ill., has issued its first bulletin under date September 1st. The experiment station was established a year ago, and is designed to carry on research work in problems of importance in engineering practice. The first issue deals with reinforced concrete beams. Exhaustive tests of various reinforcements were made, and the results are given in tables and charts. The report is prepared by Prof. Arthur N. Talbot, in charge of theoretical and applied mechanics.

Mines and Minerals, published at Scranton, Pa., issues a compact pocket directory containing a classified list of reliable manufacturers of and dealers in mining and milling machinery, supplies, etc. The directory is brought up-to-date twice a year, and is presented to subscribers of Mines and Minerals, and sold to others for the nominal sum of ten cents.

With the November number, the Technical World, of Chicago, dons a new and attractive dress, and we notice that it is now published by the Technical World Co., instead of the American School of Correspondence. Its leading article this month is The Making of the Panama Canal, by Waldon Fawcett. Among other articles of interest are, Modern Shop and Factory Lighting, Making a Talking Machine, and A Triumph of Metallurgy. The series of Great Technical Schools, which last month dealt with the University of Toronto, this month describes Perdue University. The characteristic departments of the magazine, such as Chalk Talks, Noon Hour Talks, and others, are continued in their usual happy vein.

The eighth volume of the Journal of the Mining Society of Nova Scotia contains the transactions of the society during the year 1903-4, and also publishes the papers presented to the society during the year. These deal with various topics, such as gold, coal and manganese mining, technical education, etc. Copies of the transactions may be obtained from the secretary, H. M. Wylde, at the society's rooms in Halifax.

The Department of the Interior has issued a book of cartoons advertising Western Canada as the granary of the Empire. One of the best hits in the book is a picture representing John Bull and Uncle Sam driving through the western country with only their heads visible above the grain, Uncle Sam remarking that the only drawback to the country is that "you can't see it for the wheat." Interspersed among the pictures are succinct statements of pertinent facts about the country.

Geo. A. Zeller, St. Louis, Mo., is the publisher of Spangenberg's Steam and Electrical Engineering in Questions and Answers. This is a reference book of over 600 pages, treating stationary and locomotive engineering, electricity, compressed air, mechanical refrigeration, gas and gasoline engines, hydraulic elevators, etc. It is edited by E. Spangenberg, M.E., Albert Uhl, A.I.E.E., and E. W. Pratt, all men of wide experience, the first two being connected with the St. Louis School of Engineering, and the last being master mechanic for one of the large railroads. The book is sent post-paid for $3.50, and the publisher announces that it is admitted free of duty into Canada.

The Opportunity of the Engineer is the title of the commencement address delivered at Thomas S. Clarkson Memorial School of Technology last June, by Francis N. Thorpe, Ph.D. The perusal of this address shows its author to be a man of clear intellect, deep thought, and a felicitous expression that would make any subject attractive. This address occupies nearly the whole of the July issue of the Clarkson Bulletin, issued by the school at Potsdam, N.Y.

The Steel Square Pocket Book, by Dwight L. Stoddard, New York: Industrial Publication Co., pp. 100, price 50c.

This book is, as its title indicates, a pocket book as regards size, and is a compendium of useful information for workers with the steel square. It is designed especially for the use of carpenters, and consists of over one hundred illustrations showing various uses of the square, together with just sufficient letter-press to make the illustration understood.

Reinforced Concrete. A. W. Buel and C. S. Hill. New York: The Engineering News Publishing Co., 12mo., pp. 430.

This book is intended for designing and constructing engineers following American practice, and governed by conditions which prevail in America. The first part of the book is devoted to methods of calculation, and is written by Mr. Buel, while the second and third parts, on representative structures and methods of construction, are written by Mr. Hill. The book deals with all varieties of construction in a thoroughly practical way, and yet with sufficient of the theoretical to establish the formulæ advanced. Illustrations in the form of diagrams and photographs abound throughout the book.

Manual for Engineers. Chas. E. Ferris, B.S., Professor of Mechanical Engineering, University of Tennessee, Knoxville, Tenn.; University Press.

This book is a companion of vest-pocket size for engineers and business men. It contains formulae and tables of general interest, together with a number of recipes and items of useful information. Handsome leather binding gives the book a very neat appearance.

DOMINION IRON AND STEEL CO.

At the annual meeting of the Dominion Iron & Steel Co., held last month at Montreal, the president, J. H. Plummer, spoke confidently of the outlook for both the steel rail and rod mill. The position of the company as to raw materials was better than supposed, as it had been found that the Lake Superior ore could be laid down at Sydney at very little greater cost than at Pittsburg, while European ore could be brought in as cheaply as to England. From the addresses of Frederic Nicholls and Graham Fraser, it was gathered that the whole production of the company's plant at Sydney in rails, billets and rods, could be sold in Canada and it might be decided later on to establish a mill to roll plates. The following is an extract from the report:—

"The chief source of supply is the company's mine on Belle Island, Newfoundland, known as the Wabana Mine. We shall take out this year about 315,000 tons, of which ore to the extent of 115,000 tons goes to Europe, where it has been sold at fair prices, and the balance to our own works at Sydney. There is a ready market for it in Europe, so that we can always dispose of our ore whenever that is found desirable. A new washing plant has been erected during the past spring and summer, consisting of two units, each capable of washing 100 tons of coal per hour. It is now practically complete and washing sufficient coal for two blast furnaces. While the plant is not yet doing the best work of which it is capable, coke made from washed coal is now exclusively used, and is found to be greatly improved in quality. I fully expect that as the men employed become more accustomed to the work still better results will be obtained. Five of the ten furnaces of the open hearth plant are in operation and doing fairly good work. The remaining furnaces are being carefully overhauled, and the additional

gas producers needed to complete the plant are under construction. This mill is in good condition, and of sufficient capacity to roll all the ingots we are likely to produce in the ten open hearth furnaces. In order to get the best results, and a sufficient and prompt supply of blooms for the billet and rail mills, it is necessary to remodel and enlarge parts of the present heating furnaces. Plans for the work have been prepared and the necessary materials are on the ground or coming forward, so that the improvements may be completed by the time we are ready to operate the rail mill."

The old board of directors was re-elected, and Mr. Plummer was elected President, and Mr. Nicholls vice-president.

A REMEDY FOR FRAZIL ICE.

At the first autumn meeting of the Canadian Society of Civil Engineers, a paper by R. W. Leonard was read detailing some "experiments on loss of heat from iron pipes." The fact brought out in this paper is that water when only slightly warmed loses its heat much more slowly when exposed to currents of cold air or water than when made hot. The practical application of this fact is that by forming ice racks of hollow tubes and connecting these tubes with a heating system, a remedy is provided for troubles from frazil ice. This remedy is especially applicable where there is a high head of water.

After giving data and tables gathered from his experiments, the author says:

From the above data it is possible to calculate approximately the amount of warm water it is necessary to pump through the hollow bars of a rack protecting water wheels in order to prevent the accumulation of frazil thereon, as it is necessary to raise the temperature of such bars but a fraction of a degree to accomplish this end. The curves indicate that water slightly warmed loses its heat much less rapidly than hot water when exposed in a tube to a current of ice cold water. To illustrate the practicability of this idea the example of one of the units in the extension of the Hamilton Cataract Power, Light and Traction Co.'s plant, near St. Catharines, may be taken.

The data are as follows: Head of water, 267 feet. Capacity of turbine, 245 c. ft., per sec., delivered through steel penstock 6-ft. 6-in. diameter. Power of each turbine, 6,000-h.p. Rack is 18-ft. 6-in. wide with length of 16-ft. submerged at ordinary water level.

Thin iron pipe can be flattened to serve as bars spaced as desired, and connected top and bottom with headers to form sections of the rack suitable for the circulation of warm water under pressure from a pump. The water area through the rack may be arranged to allow of a current of 1½ feet, per second, thus corresponding with the conditions existing in the experiments quoted above. Now assume the water for warming the rack to be heated to 66 deg. and returned to the heater at a temperature of 35 deg. after being exposed to a current of 1½ feet per sec., in ice cold water. This loss of 31 deg. takes place in 4 min. from a 1-in. boiler tube from 1.6 lbs. of water = 50 B.T.U.'s from a surface of 1,463 sq. ft., or, say, 34 B.T.U.'s per sq. ft. in 4 min. or 510 B.T.U.'s from 1 sq. ft. per hour. The total pipe surface submerged in such a rack equals 695.3 sq. ft., therefore transmission of heat from whole rack per hour equals 354,603 B.T.U.'s.

Assume a boiler evaporating 9 lbs., water from and at 212 deg. F. per lb., coal or yielding 8,694, B.T.U.'s per lb., coal (latent heat 966 B.T.U.'s.) Therefore, the coal required per hour to warm water equals 41 lbs., requiring a grate area of 5 sq. ft. (with 8 lbs. coal burned per hour per sq. ft. grate area), or a boiler of 15-h.p. The quantity of water to be heated may be arrived at as follows: 1.6 lbs., water loses 31 temp., in 4 min., or at the rate of 290 B.T.U.'s per hour. Total loss from rack (as above), 354,603 B.T.U.'s requiring a circulation of 1,223 lbs., per hour or 122 gallons, or little over two gallons per minute. In order to avoid difficulties caused by the freezing of the water in the bars of the rack when the heating system is not being used, it would be desirable to use some fluid which freezes only at a very low temperature. It would appear that the same principle can be economically used to prevent the accumulation of frazil on other hydraulic machinery, such as water wheel casings, etc. It will be apparent to the reader that with a lower head of water and a corresponding increased volume, the circulation of a proportionately larger quantity of warm water would be necessary in order to effect the purpose desired, and there comes a point at which the object attained is not worth the expenditure of fuel necessary for the purpose.

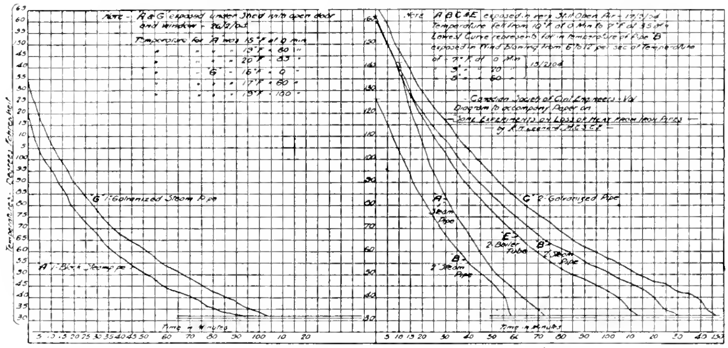


Fig 1. Fig 2.

BOILER SCALE AND THE SUNNYSIDE CASE.

Editor Canadian Engineer:—

Sir,—Please correct an incomplete print of my letter in October issue, concerning the analysis of scale in the boiler which exploded recently at Sunnyside. The following is the complete analysis:

	No. 1. Sunnyside, Humber Bay Feed.	No. 2. Toronto Water.	No. 3. Toronto Water, B. Comp Used.	No. 4. Artesian Well.
Oil	0.40	0.00	0.00	9.03
Organic matter and water of combination	7.79	10.58	3.62	0.44
Carb. of lime	57.55	52.02	72.86	74.96
Sulphate of lime	4.87	9.29	0.51	0.20
Carb. of magnesia	0.00	1.22	8.97	6.61
Magnesia	19.72	13.81	7.03	3.40
Oxide of iron and alumina	2.94	3.12	3.42	1.65
Salt	0.00	0.00	0.07	Trace.
Silica	5.59	9.96	3.52	3.71
Undetermined	1.14	0.00	0.00	0.00
	100.00	100.00	100.00	100.00

THE "HARRIS-ANDERSON" PATENT FEED-WATER PURIFIER.

In modern power installations the importance of the complete removal of oil from the condensed steam that has to be used over again as feed-water is fully recognized by engineers who have any regard for the safe and economical working of their boilers, and efforts have for long been made, with varying success, to effect this much-desired result.

Steam separators and mechanical filters, while they are a step in the right direction, have not of themselves been found to completely overcome the difficulty of extracting the finest particles of oil from the water.

It is claimed for the Harris-Anderson apparatus, which we illustrate, that it affords a complete solution of the problem in a very simple and ingenious way, and working automatically, it effects the removal of all oil, whether free or emulsified, and leaves the feed-water brilliantly clear and in every way fit for boiler use.

The removal of the free oil in feed-water can be more or less effected by many filtering devices: it is the extraction of the finely-divided or emulsified particles, too small to be retained by any filtering medium, which has hitherto presented an insuperable difficulty. The difficulty has, however, been overcome at last by the Harris-Anderson system, which, speaking broadly, consists in the formation of a precipitate in the water, which envelops the particles of oil, rendering them capable of removal by filtration.

The formation of this precipitate is effected by the addition to the water of minute quantities of two mutually interacting reagents, quite innocuous to the boiler plates or fittings. The reagents are supplied to the machine in a solid form, and in any convenient quantity, while the machine supplies them to the water in the exact proportion desired, independently of any variation in the quantity of water passing through the apparatus. Thus, all need for weighing out, dissolving, and regulating the reagents on the part of an attendant is dispensed with. The principle upon which the machine supplies the reagents to the water in the required proportions, and independently of any change in the rate of flow, is as follows:

Two small equal fractions, usually 1 per cent., are taken from the total quantity of water, and are passed to two cylinders called "solutioners," where they are charged respectively with the reagents, and are converted into solutions of any desired strength. These solutions are then returned to the main body of the water.

The apparatus for parting off these fractions from the water is called the distributor, and is shown in Fig. 1. It consists of a Turbine B, into the upper part of which the water from the condenser is led, and from which it is discharged by the nozzles E into an annular trough formed between F and A. As the turbine revolves, the stream of water from each nozzle is delivered uniformly over the annular trough, and therefore the total water is evenly distributed over its surface.

In order to divide the fractional parts from the total water in the desired proportions, radial partitions are provided in the annular trough, forming the compartments H and J, each of which measures at the circumference 1 per cent. of the total circumference of the annular space. It is evident, therefore, that these radial compartments will each withdraw 1 per cent. of the total amount of water passing from the turbine, no matter what the quantity flowing may be.

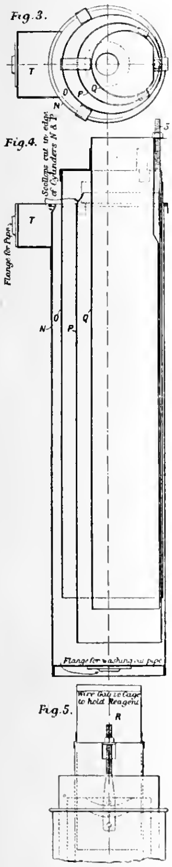
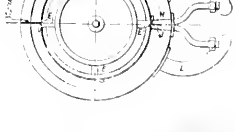


Fig. 6.



The construction of the turbine is very simple, and the means adopted to reduce friction are ingenious and effective. As will be seen on reference to the figure, the revolving part B C of the distributor works round a central vertical spindle M, and is guided on ball-bearings on top and bottom. It also floats in the water contained in the vessel F, so that any friction there may be is reduced; indeed, it is so slight that a very small flow of water is sufficient to keep the apparatus working. The water, which is divided off from the main body by the two radial pockets H and J, is led away by pipes to the two solutioners, while the remainder of the water passes away through the pipes K and L to a mixing vessel mentioned hereafter.

The solutioners are fed, as before stated, with the solid reagents, which are dissolved up by the water led from the small pockets of the distributor. The two reagents—sulphate of alumina and carbonate of soda—are placed separately in a gauge container at the top of each solutioner, as shown at R, Fig. 5. The bottoms of these containers dip about two inches in the water, and as the reagent is gradually dissolved away at the bottom, that above takes its place until the whole is dissolved. The water taken from each pocket of the distributor is made into a solution of any desired strength by a very simple automatic arrangement, depending upon the balancing of a column of solution by a definite and adjustable column of water. The strength of the solution is independent, both of the amount of water passing through the apparatus, and of the amount of solid

reagent present, and only depends upon the setting of the apparatus. The solutioner contains no valves, and requires no attention beyond the first adjustment. Their action can, perhaps, be better described by reference to Fig. 5. The solutioner consists of four cylindrical vessels, which fit one within the other, as shown. The gauze wire container, into which the reagent is put, is shown at R, the bottom of it being about two inches below the level of the scallop at top of cylinder N, Fig. 4. The water which comes from one of the pockets in the distributor is led by a pipe into the space between the cylinders P and Q. The water passes down the space between P and Q, and fills up the whole of the apparatus to the level of the scallop at top of N, dissolving the reagent, and forming a strong solution. The water which continues to flow down between the cylinders P and Q meets the strong solution descending from the cage, at the bottom of the apparatus, and carries it into the outlet space between N and O, and away over the scallop into the receiver T. This outer space then contains a column of solution, which is balanced by the column of water in the space between P and Q. This column of water must be longer than the column of solution, so that as the solution increases in strength the level of the water in the space between P and Q rises. When the outflowing solution attains a certain strength, water overflows at the scallop at the top of cylinder P, passes down the space between O and P, mixes with the solution at the bottom of the outlet space, and prevents it from getting any stronger. The amount of water flowing over this inner scallop automatically adjusts itself to keep the solution at constant strength, which can be regulated to a nicety by the screw shown at S, which raises or lowers the cylinder P, thus increasing or diminishing the difference in the head of water flowing over the scallop on N and the scallop on P. So delicate is the adjustment possible that any required degree of strength can be given to the solution flowing over the scallop on N, and this strength will be maintained so long as the reagent lasts, no matter what the variation may be in the quantity of water flowing through the solutioner; and the apparatus requires no attention whatever, except the occasional addition of reagent to the gauze basket.

Thus the machine supplies to the water, automatically and continuously, the exact amounts of the two reagents required per 1,000 gallons, whatever be the actual quantity of water passing. This is of special importance when the load is very variable, as in electric light stations.

The water, after the addition of the solutions, made as described, is passed through a treatment vessel in which the reagents act upon one another, and thus render the oil filterable. This reaction is very rapid, taking place in some two minutes. The water is made to traverse a definite path by means of deflection plates, so as to insure its being subjected to treatment for a sufficient time for the reaction to become complete. In this way the water is continually entering the apparatus at one end and passing out at the other.

After this treatment the water is found to have lost its milky appearance, the individual particles of oil, which could not previously be distinguished by the eye, having become entangled with the precipitate, forming visible masses readily capable of filtration. From the treatment vessel the water passes to the primary filter, a detail of which is not shown. This filter is constructed in sections working in parallel, each section arranged to be isolated and cleansed by a reverse stream of water, while the others continue to do duty. In these the coarser particles of the oil are removed.

From the primary filters the water passes to a small collecting tank, whence it is conducted to the filter proper.

In order to show pictorially the results of this process, as compared with mechanical filtration alone, we reproduce four photographs, which speak for themselves. The first shows water taken straight from the condenser; the second, the same water after careful mechanical filtration; the third, the same water purified by the Harris-Anderson system; and the fourth, for the sake of comparison, a similar bottle of pure distilled water.

After the completion of the process, the only residue in the water is a minute trace of soda salts, which, of course, have no harmful action on the boiler, but which tend, if anything, to prevent the formation of scale. The cost of the reagents seldom exceeds, and is usually less than one cent. per 1,000 gallons of water treated.

The Harris-Anderson apparatus is now in constant use at a large number of power stations in Great Britain, with excellent results obtained from an extended experience, and an installation of this machine can now be seen at work at the factory of Messrs. Pugsley, Dingman & Co., Toronto Junction, makers of Comfort Soap. Here the machine is treating 500 gallons of water per hour, which is the condensed exhaust of the main engine and several large pumps, and contains a large quantity of emulsified oil. This used to be run to waste into the sewers, but now passes through the purifier, and, after the removal of the oil, is fed to the boilers, and, being already at a temperature of 160 deg. Fahr. before going to the heater, represents a considerable economy. It is besides pure distilled water, containing no scale-forming properties. Examination of the boilers after only fifteen days' working showed a considerable reduction of scale on the heating surfaces and no traces of oil in the boiler.

Arrangements to inspect this plant can be made by communicating with John T. Webster, 109 Niagara Street, Toronto, agent for the purifier for Canada.

USE OF THE STROBOSCOPE.

It is a peculiarity of vision that impressions on the retina do not fade instantly but persist for a fraction of a second after a change has taken place in the aspect of the object viewed. This persistence of vision is what enables a fairly good view of a fair ground or baseball field alongside of a railroad track to be seen from the window of a rapidly-moving train, when, if the train were standing still, all that could be seen would be a high fence with narrow cracks between the vertical boards. When the car carries one by the fence rapidly the eye receives a series of views of the field through the cracks, which blend together and give the panorama effect. This peculiarity is taken advantage of in investigating the action of certain vibrating or revolving mechanisms like engine flywheel governors, etc. If a rapidly-running flywheel governor is seen for a fraction of a second at one spot at every rotation, it appears to the eye to stand in space and under that condition the in-and-out movements caused by changing load, may be readily seen. One method of obtaining this effect is to mount a radially-slotted disk on the flywheel shaft so that the slot covers the portion of the governor to be watched. In front of this disk is another slotted disk which stands stationary. Now if a strong light illuminates the object a flash of reflected light will reach the eye at every revolution. The same stroboscope effect was obtained in another way in the elaborate investigations of the Pelton water wheel which were carried on some months ago. To perfect the shape of these buckets so that they should have the maximum of efficiency and durability it seemed necessary to observe the action of the jet as it impinged on the buckets, but to get a perfect visual impression the buckets should stand still, which, of course, was impossible in running tests. An arc lamp was arranged with a shutter, which was worked in synchronism with the revolving water wheel. At every revolution a flash of light was directed upon the jet and buckets, giving them the impression of standing still while the water entered the buckets and flowed out at the sides. With the same apparatus instantaneous photographs of the jet and buckets were taken.—Machinery.

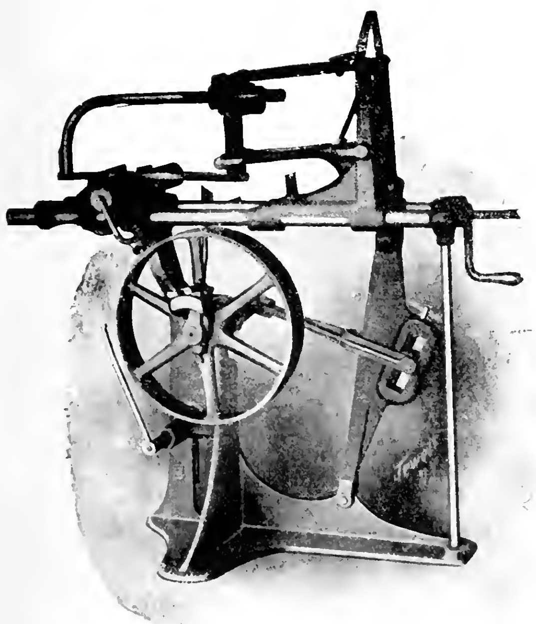
Henry Disston & Sons, Philadelphia, manufacturers of saws, files, etc., are locating a factory in Hamilton.

H. M. Whitney, the Boston millionaire, has purchased the asbestus mines at Thetford, Que., from the King estate. The purchase price is said to be $125,000. The asbestus mines will be worked on a large scale.

THE FAIRBANKS POWER HACK SAW.

The accompanying cut represents the Fairbanks Power Hack Saw, which is being manufactured and sold by the Fairbanks Co., throughout Canada. This saw was designed for the purpose of combining speed, accuracy, durability and economy, and the results obtained in each particular enable the makers to claim that it is superior to any machine on the market. Several of these saws have been placed in large manufactories throughout Canada, and to thoroughly appreciate the value of this machine it must be seen in operation. It is of interest to the shop-owner because it is durable, saves saws, and increases the output, while its simplicity and convenience please the operator. Although it has advantages lacking in other makes of saws, the cost is about the same.

The Fairbanks Power Hack Saw has been built to satisfy the demand for a reliable and economical saw. It is constructed on correct mechanical principles, for longest wear, and to obtain the best and greatest amount of service from hack saw blades. It is a compact and self-contained machine of a high grade, using saws from 9 to 14 inches long, though especially intended for blades up to 12 inches in length. It does the cutting on the pulling stroke, with weight of saw frame and levers lifted off the blade on its forward or idle stroke. This arrangement keeps the saw blade sharp longer, and enables it to do thirty per cent. more work than machines of ordinary construction.

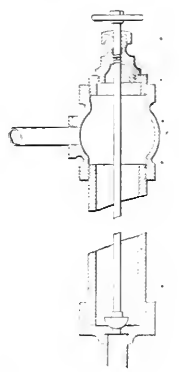


One of its valuable features is the spring tension, which acts on the saw frame, and is much more effective and convenient than the weights with which hack saws are ordinarily equipped. The connection from the pulling end of saw blade to main lever is rigid. The steel overhanging saw arm gives a constant tension to the blade, and facilitates the quick insertion of blades or changing for different lengths. The stroke of the saw blade is readily changed while the machine is in motion, thus utilizing the full length of the blade for effective work. The stroke may be varied from 6¼ inches to 8 inches to suit the size of work being cut. It has means for adjusting the saw blade to make it cut straight or squarely through a piece of stock, even when the blade has more clearance, or is duller on one side than the other. It has a driving clutch that locks the crank to the driving pulley, without end friction on the bearings with its consequent loss of power. It is provided with an adjustable automatic stop that will always stop the machine when the cut is finished. The stop may be quickly set to stop the machine when the saw has cut partly through a piece, and it will operate positively to within 1-32-inch from the point where it is desired to end the cut. The machine is so quickly and yet so easily handled that it is almost impossible for even a careless operator to pinch or jam his hand in operating it, a fault very common with many of the machines on the market. Further information will be furnished by the Fairbanks Co., Montreal, or by any of its branch houses.

A HOME-MADE STEAM TRAP.

At the recent meeting of the New England Cotton Manufacturers' Association, Thomas H. Smith described, as follows, a home-made steam trap which he had invented:

"It consists of three feet of two-inch pipe with a cap on the top, and the stem and gland of a ¼-inch valve inserted in the top. That stem is attached to a brass rod 5-16-in inch diameter. On the bottom of the rod is a little hemispherical piece of packing, which is sufficiently hard to resist the action of steam. If you get anything softer than this, the steam will melt away. The ratio of expansion of brass and iron is practically as three is to two; that is, you will have three points of expansion in brass to two in iron. Steam at 50 pounds' pressure contains 297 degrees of temperature. Taking 200 degrees as the difference between the inlet steam and the outlet water, a 30-inch trap gives nearly 1-32 inch in expansion, which is sufficient to drain the trap. I have noticed that this trap has one advantage—the trap is open when it is empty. That should be the case with all traps, so that when the steam is turned on the water will drain out of the pipes, and the pipes can also drain themselves after the steam is turned roff. Turn the steam on, and the water will come out of the half-inch pipe and fill the pipe at a low pressure. As soon as the steam begins to come, the rod will close the valve entirely. After that it will open itself slightly and allow the water to trickle out in a hot stream. With this little valve arrangement at the top, you can set it so that more or less steam may pass."



Home-made Steam Trap.

ON INSULATION.

(Concluded from October issue.)

5. That insulators of any description should have a high insulation per mil of thickness is a very important matter, especially in generators and motors, when looked at from the "space factor" point of view. It is surprising what a large percentage of the available winding space is taken up by insulation in generators and motors, more especially in high-tension alternating-current work.

Having considered in detail the points of good insulation, it remains to consider what tests can be conveniently made with a view to securing a many good points in the insulation used, always bearing in mind that electrical tests are by far the most convenient in a manufacturing works, which is generally far from being a chemical laboratory. Particulars of tests as published by manufacturers of insulation are at times misleading, as frequently it is not stated whether the breakdown voltage was with continuous current or alternating current, and if the latter, whether the value is R.M.S. or maximum. Further, some manufacturers test between terminals shaped hemispherically and others between two flat discs. Again, some only test for an instant at the voltage named, merely bringing the voltage up and down again. It is possible, therefore, for the material to break down under a much lower voltage even if only sustained for a short time. Information of this description is of no use to the designer; that will readily be understood. Consequently some systematic way of testing all insulating materials is required. This need only be

"thorough" on first testing a new material, as there will be probably many evidences visible on mere inspection which would lead one to expect changes in the material. Subsequently a far less pretentious test will be all that is required to ensure repeat orders of material being satisfactory. As the best means for obtaining high pressures, and also of varying the pressure, is by means of alternating current; this, of course, should be used. It must be noted that varying periodicity would give varying results; also, that the shape of E.M.F. curve affects the results in the same way, a peaky curve being more apt to break down the insulation than a flat curve, though both may have the same R.M.S. value. An alternator giving fifty periods and approximately a sine curve of E.M.F. would be suitable, and would correspond somewhat to prevailing practice in alternating-current work in England. A variable-ratio transformer is practically indispensable for obtaining the varied voltages required to test the different classes of insulators. Though it may be possible at times to use one of two machines for testing purposes, it is preferable to stick to one (unless the machines are identical), as the more constant the conditions of testing the more reliable is the information obtained. The larger the works and the more elaborate might be the testing, but however simple the apparatus, it is desirable to pressure test all insulating papers, etc., at varying temperatures on first testing unknown materials; afterwards it would probably only be necessary to test at one temperature, supervision being kept over the appearance of all materials, as variations from the standard article are thus detected. Supervision is most essential in connection with varnishes and paints, and attention to appearance should, if possible, be supplemented by testing with the hydrometer to see that the specific gravity does not change. This is partly a check on its chemical constituents, any alteration in chemical composition generally affecting its specific gravity.

Taking tests for the specific points mentioned for insulating materials in the foregoing in the order named, we have for paints and varnishes:

1. Quick Drying.—This is merely a matter for trial, and can be done either in the open air or in a drying-stove, as desired.

2. Elastic Strength.—This may be tested by coating a piece of presspahn, tin or copper (metal for preference), and when dry bending backwards and forwards. An electrical test can also be made after the bending to see if this has affected the insulating material.

3. High Melting Point.—First dry off the liquid components and then heat the residue, and see at what temperature it melts. If the drying was done in a thin layer, it would also be possible to note when it commenced to char.

4. Affecting Copper.—Copper strips may be coated and examined after an interval (which is practically working conditions), but a quicker way is to put copper filings into a quantity of the varnish. They will readily show if the varnish will in any way affect the copper.

5. Waterproof, etc.—The varnish or paint could be tested on some plant about the works, where there is generally some motor or other running under adverse circumstances as regards oil, etc. A test might be made of a piece of metal left exposed to the elements for some considerable time.

6. This we will deal with later, along with 4 and 5 for fibres, etc.

Taking now fibres, papers, etc., we find—

1. Pliability.—This is, of course, purely a matter of trial.

2. Creasing.—A good test to subject the material to is to make two creases crossing each other. This is likely to be as severe as anything short of an actual tear.

3. Non-Hygroscopic.—This might be tested by immersing all samples systematically for a short time in water and then testing for breakdown after drying the surface.

The tests for 4 and 5 for fibres, papers, etc., and for 6 in varnishes and paints, can conveniently be made in a felt-lined box, heated by either lamps or a resistance frame, the latter for preference if the higher temperatures are desired. If a thermometer be fixed projecting into the box, the desired temperature is easily noted, and can be regulated by varying the current through the resistance. The box should be fitted with two terminals about 1½ in. in diameter, the flat surfaces having the sharp edge rounded off to prevent excess of pressure at these points. If one of the terminals be fitted with a flat spring, a fairly uniform pressure will be secured, as the thickness of the samples tested does not vary within very wide limits. Ordinary instruments would be necessary for reading current and voltage, the ammeter indicating at once the breakdown of any specimen under test. It is the systematic recording and making of these electrical tests that enable the designer to make the most of the materials at his disposal. They also, as previously noted, keep the materials used up to sample, and, therefore, more reliance can be placed on the work of the various departments. One point remains to be emphasized in pressure tests, and that is that the breakdown strength is not proportional to thickness, especially in the case of fibres and such like materials which are built up in layers. It would appear very difficult to get rid of moisture in the thicker sheets, and this brings down the insulating strength.

A very important test which should not be overlooked is the galvanometer test for leakage, as some materials may be good against piercing and yet be bad from a leakage point of view. Take mica-paper for instance. This, if the mica is well laid—that is, with all joints well lapped—will show well under a disruptive test, but for leakage would depend entirely on the mucilage or varnish with which the mica flakes are built up. Failing a standard galvanometer testing set, a rough test may be made by testing against a known good insulator, and noting the discharge and the length of surface over which it takes place. This can, of course, only be done when the thickness of the piece tested is secure against breakdown from the pressure applied to obtain this discharge. Every care should, of course, be taken to accurately gauge the thickness of material under test, especially at the point of breakdown.

In conclusion, it may be said that attention to this question of insulation is amply repaid, and it is well to bear in mind that it is not well "to spoil the ship for a ha'porth of tar."—Electrical Engineer, London.

CEMENT SPECIFICATIONS.

The Canadian Engineer for March, 1902, gave details of standard Portland cement tests as prepared by a committee of the Canadian Society of Civil Engineers.

We here give the specifications for Portland and natural cements adopted by the American Railway Engineering and Maintenance-of-Way Association. There is also appended the specifications for concrete as submitted by the committee of the Association. Though the convention did not pass upon the concrete specifications, they were considered of such importance as to justify publication in this form.

Portland Cement.

Portland cement is a product of the mixture of clay and lime-carbonate in definite proportions, calcinated at a high temperature and reduced to a fine powder. Cement shall be packed in well-made wooden barrels lined with paper, or in strong cotton or paper sacks. Each package shall be plainly marked with the brand and name of the manufacturer, and the net weights shall be exact and uniform. One barrel shall contain not less than 376 pounds of cement, and four sacks shall be equivalent in weight to one barrel. All cement shall be delivered in sound packages, undamaged by moisture or other causes. Cement must be stored, until used, in a perfectly dry place in such manner as will ensure it from all damage. All cement failing to meet the requirements of the specifications may be rejected, and all rejected cement, whether damaged or rejected for other causes, shall be removed at once from the company's property.

All cement shall be subjected to the following tests: (1) The selection of the sample for testing, the number of packages sampled, and the quantity taken from each package, must be left to the discretion of the engineer, but each sample

should be a fair average of the contents of the package from which it is taken. At least one barrel in every ten should be sampled. (2) Cement in barrels should be sampled through a hole made in the centre of one of the staves, midway between the heads, or in the head, by means of an auger or sampling iron similar to that used by sugar inspectors. If in bags, it should be taken from surface to centre. (3) All samples should be passed through a sieve having twenty meshes per linear inch in order to break up lumps and remove foreign material. For determining the characteristics of a carload of cement the individual samples may be mixed and the average tested; where time will permit, however, each sample will be tested separately.

Not less than 94 per cent. of the cement tested shall pass through a No. 100 standard sieve. The standard sieve shall be circular, about 20 cm. (7.87 ins.) in diameter, 6 cm. (2.36 ins.) high, and provided with a pan 5 cm. (1.97 ins.) deep and a cover. The wire cloth in the sieve to be woven (not twilled) from brass wire having a diameter of 0.0045 ins. This cloth to be mounted in the frame without distortion; the mesh should be regular in spacing, and for a No. 100 sieve shall contain not less than 96 nor more than 100 meshes per linear inch. The cement to be thus tested shall be thoroughly dried at a temperature of 100 C. (212 degrees Fahr.) before sieving.

Set.—(1) Initial set shall not occur in less than thirty (30) minutes. (2) Final set shall not occur in less than one hour nor more than ten hours. (3) The time of setting shall be determined by means of the Vicat needle apparatus, as recommended by the committee of the American Society of Civil Engineers upon uniform tests of cement in conjunction with the committee of the International Association for Testing Materials. (4) Using a paste composed of neat cement and water, of normal consistency, the initial set is said to have commenced when the needle ceases to pass a point 5 mm. (0.20-in.) above the upper service of the glass plate in the Vicat apparatus, and is said to have terminated the moment the needle does not sink visibly into the mass. (5) The paste is of normal consistency when the cylinder of the Vicat apparatus penetrates to a point in the mass 10 mm. (0.39-in.) below the top of the ring. (6) The amount of water required to make a paste of normal consistency varies with different cements, but will be found to be approximately 20 per cent. of the weight of the cement. It should have a temperature of 70 degrees Fahrenheit.

Soundness.—(1) A pat of neat cement 2½ to 3 inches in diameter, ½-inch thick at centre, tapering to a thin edge, and allowed to take its final set in moist air, must withstand indefinite exposure in water or air at any ordinary temperature without checking, distortion or softening. (2) A pat of neat cement, as above, placed in water, which shall be slowly raised to the boiling point and then maintained in that condition for three hours and allowed to cool gradually, shall not show any signs of checking, distortion or softening. The same result should follow exposure to steam not under pressure for three hours. This test may or may not be cause for rejection, at the option of the engineer in charge.

Tensile Strength.—(1) The briquette used in testing shall be formed in moulds of the size and form now in customary use and recommended by the American Society of Civil Engineers, the stress to be applied at a uniform rate of 600 pounds per minute until fractured. (2) All briquettes of neat cement are to be made from paste of normal consistency in the following manner: The moulds shall be filled with the paste as soon as it is thoroughly mixed and tempered, the material pressed in firmly with the fingers and smoothed off with a trowel without ramming; the material should be heaped up on the upper surface of the mould, and in smoothing off the trowel should be drawn over the mould in such a manner as to exert a moderate pressure upon the excess material. The mould should then be turned over and the operation repeated upon the other side. (3) Briquettes for twenty-four-hour tests shall be allowed to set twenty-four hours in moist air. (4) Briquettes for seven and twenty-eight day tests shall be allowed to set one day in moist air and remainder of period in water. (5) All briquettes are to remain in the water until they are placed in the testing machine, except in the case of twenty-four-hour tests. (6) Neat twenty-four-hour tests shall not show less than 125 pounds per square inch. Neat seven-day tests shall not show less than 400 pounds per square inch. Neat twenty-eight-day tests shall not show less than 500 pounds per square inch, and should show at least 10 per cent. increase above the seven-day test.

The specific gravity, determined upon dried cement which has passed through a No. 100 sieve, shall not be less than 3.10 nor more than 3.30. The specific gravity can be conveniently and accurately determined by the use of Le Chatelier's apparatus, as recommended by the committee on uniform tests of cements. Chemical analyses should show not more than 5 per cent. of magnesia, nor more than 1.75 per cent. of sulphuric anhydride. If in the tests of any given brand of cement any sudden, irregular or wide variation from its normal action is found, it should be withheld from use until more extended tests shall have demonstrated its reliability.

Natural Cement.

Natural cement is a product formed of calcinated limestone containing clay and carbonate of magnesia reduced to a fine powder. Cement should be packed in well-made wooden barrels lined with paper, or in strong jute or paper sacks. Each package shall be plainly marked with the brand and name of the manufacturer, and the net weights shall be exact and uniform. One barrel shall contain not less than 300 pounds of cement. (West of the Alleghany Mountains this may be 265 pounds.) Three paper sacks of cement shall be equivalent in weight to one barrel. All cement shall be delivered in sound packages, undamaged by moisture or other causes. Cement must be stored until used in a perfectly dry place in such manner as will ensure it from all damage. All cement failing to meet the requirements of the specifications may be rejected, and all rejected cement, whether damaged or rejected for other causes, shall be removed at once from the company's property. All cement shall be subject to the following tests:

Test Sampling.—(1) The selection of the sample for testing, the number of packages sampled, and the quantity taken from each package, must be left to the discretion of the engineer, but each sample should be a fair average of the contents of the package from which it is taken. At least one barrel in every ten should be sampled. (2) Cement in barrels should be sampled through a hole made in the centre of the staves, midway between the heads, or in the head, by means of an auger or sampling iron similar to that used by sugar inspectors. If in bags, it should be taken from surface to centre. (3) All samples should be passed through a sieve having twenty meshes per linear inch in order to break up lumps and remove foreign material. For determining the characteristics of a carload of cement the individual samples may be mixed and the average tested; where time will permit, however, each sample shall be tested separately.

Fineness.—Not less than 80 per cent. of the cement tested shall pass through a No. 100 standard sieve. The standard sieve shall be circular, about 20 cm. (7.87 ins.) in diameter, 6 cm. (2.36 ins.) high, and provided with a pan 5 cm. (1.97 ins.) deep and a cover. The wire cloth in the sieve to be woven (not twilled) from brass wire having a diameter of 0.0045 ins. This cloth to be mounted in the frame without distortion; the mesh should be regular in spacing and for a No. 100 sieve shall contain not less than 96 nor more than 100 meshes per linear inch. The cement to be thus tested shall be thoroughly dried at a temperature of 100 C. (212 degrees Fahr.) before sieving.

Set.—Initial set shall not occur in less than twenty (20) minutes. (2) Final set shall not occur in less than forty-five (45) minutes nor more than four (4) hours. (3) The time of setting shall be determined by means of the Vicat needle apparatus, as recommended by the Committee of the American Society of Civil Engineers upon uniform tests of cement in conjunction with the Committee of the International Association for Testing Material. (4) Using a paste composed of neat cement and water, of normal consistency, the initial set is said to have commenced when the needle ceases to pass a point 5 mm. (0.20 ins.) above the upper surface of the glass plate in the Vicat apparatus, and is said to have terminated the moment the needle does not sink visibly into the mass. (5) The paste is of normal consistency when the cylinder of the Vicat apparatus penetrates to a point in the mass 10 mm. (0.39 ins.) below the top of the ring. (6) The amount of water required to make a paste of normal consistency varies with different cements.

but will be found to be approximately 30 per cent. of the weight of the cement. It should have a temperature of 70 degrees Fahrenheit.

Soundness.—(1) A pat of neat cement 2½ to 3 inches in diameter, ½-inch thick at centre, tapering to a thin edge, and allowed to take its final set in moist air, must withstand indefinite exposure in water or air at any ordinary temperature without checking, distortion, or softening. (1) The briquette used in testing shall be formed in moulds of the size and form now in customary use and recommended by the American Society of Civil Engineers, the stress to be applied at a uniform rate of 400 pounds per minute until fractured. (2) All briquettes of neat cement are to be made from paste of normal consistency in the following manner: The moulds should be filled with the paste as soon as it is thoroughly mixed and tempered, the material pressed in firmly with the fingers and smoothed off with a trowel without ramming; the material should be heaped up on the upper surface of the mould, and in smoothing off the trowel should be drawn over the mould in such a manner as to exert a moderate pressure upon the excess material. The mould should then be turned over and the operation repeated on the other side. (3) Briquettes for twenty-four-hour tests shall remain in moist air until final set has occurred, then be placed in water for the remainder of period. (4) Briquettes for seven and twenty-eight-day tests shall be allowed to set one day in moist air and remainder of period in water. (5) All briquettes are to remain in the water until they are placed in the testing machine. (6) Neat twenty-four-hour tests shall not show less than 60 pounds per square inch. Neat seven-day tests shall not show less than 100 pounds per square inch. Neat twenty-eight-day tests shall not show less than 150 pounds per square inch, nor less than 25 per cent. above the seven-day test.

The specific gravity, determined upon dried cement which has passed through a No. 100 sieve shall not be less than 2.50 nor more than 2.80. The specific gravity can be conveniently and accurately determined by the use of Le Chatelier's apparatus as recommended by the committee on uniform tests of cements.

If in the tests of any given brand of cement, any sudden, irregular or wide variation from its normal action is found, it should be withheld from use until more extended tests shall have demonstrated its reliability.

Owing to insufficient data, the committee was not prepared to specify a sand test in either class.

Portland Cement Concrete.

Cement shall be Portland, either American or foreign, which will meet the requirements of the standard specifications. Sand shall be clean, sharp and coarse, but preferably of grains varying in size. It shall be free from clay, loam, sticks and other impurities. Stone shall be found, hard and durable, crushed to sizes not exceeding two inches in any direction and freed from dust by screening. Gravel shall be composed of clean pebbles of hard and durable stone, of sizes not exceeding two inches in diameter, free from clay and other impurities except sand. When containing sand in any considerable quantity, the amount per unit of volume of gravel shall be determined accurately to admit of the proper proportion of sand being maintained in the concrete mixture. Water shall be clean and reasonably clear, free from sulphuric acid or strong alkalies.

Mixing by Hand.—(1) Tight platforms shall be provided of sufficient size to accommodate men and materials for the progressive and rapid mixing of at least two batches of concrete at the same time. Batches shall not exceed one cubic yard each, and smaller batches are preferable, based upon a multiple of the number of sacks to the barrel. (2) Spread the sand evenly upon the platform, then the cement upon the sand, and mix thoroughly until of an even color. Add all the water necessary to make a thin mortar and spread again; add the gravel if used, and finally the broken stone, both of which, if dry, should first be thoroughly wet down. Turn the mass with shovels or hoes until thoroughly incorporated and all the gravel and stone is covered with mortar; this will probably require the mass to be turned four times. (3) Another approved method, which may be permitted at the option of the engineer in charge, is to spread the sand, then the cement, then the gravel or broken stone; add water and mix thoroughly as above.

Mixing by Machine.—A machine mixer shall be used wherever the volume of work will justify the expense of installing the plant. The necessary requirements for the machine will be that a precise and regular proportioning of materials can be controlled and the product delivered be of the required consistency and thoroughly mixed. The concrete shall be of such consistency that when dumped in place it will not require much tamping. It shall be spaded down and tamped sufficiently to level off, and will then quake freely, like jelly. (1) Each course should be left somewhat rough to insure bonding with the next course above; and if it be already set, shall be thoroughly cleaned and dampened before the next course is placed upon it. The plane of courses shall be as nearly as possible at right angles to the line of pressure. (2) An uncompleted course shall be left with a vertical joint where the work is stopped. (3) The work should be carried up in sections of convenient length and completed without intermission.

Expansion Joints.—(1) In exposed work expansion joints shall be provided at intervals of thirty feet to fifty feet. A temporary vertical form or partition of plank shall be set up and the section behind completed as though it were the end of the structure. The partition will be removed, when the next section is begun and the new concrete placed against the old without mortar flushing. Locks shall be provided if directed or called for by the plans. (2) In reinforced or steel concrete the length of these sections may be materially increased at the option of the engineer. Concrete shall be placed immediately after mixing and any having an initial set shall be rejected. About one inch of mortar of the same proportions as used in the concrete may be placed next to the forms, immediately in advance of the concrete, or a shovel facing made, at the option of the engineer in charge.

Forms.—(1) Forms shall be substantial and unyielding, properly braced or tied together by means of wire or rods. (2) The material used shall be of dressed lumber, secured to the studding or uprights in horizontal lines. (3) Planking once used in forms shall be cleaned before being used again. (4) The forms must not be removed within forty-eight hours after all the concrete in that section has been placed. In freezing weather they must remain until the concrete has had a sufficient time to become thoroughly set. (5) In dry but not freezing weather, the forms shall be drenched with water before the concrete is placed against them. (6) For backings, undressed lumber may be used for forms.

Finishing.—(1) After the forms are removed, any small cavities or openings in the concrete shall be neatly filled with mortar if necessary. Any ridges due to cracks or joints in the lumber shall be rubbed down; the entire face shall then be washed with a thin grout, of the consistency of whitewash, mixed in the proportion of one part of cement to two parts of sand. The wash should be applied with a brush. (2) The tops of bridge seats, pedestals, copings, wing walls, etc., when not finished with natural stone coping, shall be finished with a smooth surface composed of one part cement to two parts of granite, or other suitable screenings, or sand applied in a layer 1 to 1½ inches thick. This must be put in place with the last course of concrete. (3) In arch tops, a thin coat of mortar or grout shall be applied over the top to thoroughly seal the pores.

STRUCTURE.	PARTS BY VOLUME.			
	Cement.	Sand.	Gravel.	Broken Stone.

The proportion of the materials in the concrete shall be as specifically called for by the contract, or as set forth herein, upon the lines left for that purpose; the volume of cement to be based upon the actual cubic contents of one barrel of specified weight.

The Canadian Engineer

VOL. XI.—NO. 12. TORONTO AND MONTREAL, DECEMBER, 1904. PRICE 10 CENTS / $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE
CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY, MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada, Great Britain and the United States, $1.00 per year, foreign, 6s. Advertising rates on application.

OFFICES—18 Court St. Toronto ; and Fraser Building, Montreal.
Toronto Telephone, Main 4310. Montreal Telephone, Main 2589.
BIGGAR-SAMUEL, LIMITED, Publishers,

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 15th of the preceding month or if proof is desired, 4 days earlier.

CONTENTS OF THIS NUMBER.

TO OUR READERS.

In closing the eleventh year of the Canadian Engineer, we desire to thank our readers and advertisers for the confidence they have shown in the paper, as manifested in their steadily increasing support.

We have now arrived at a point where the interests covered by the Canadian Engineer can be advantageously specialized, and in order to give better service and more matter to those of our readers who are solely interested in mechanical engineering, we have decided to start in January a new paper to be called

"THE CANADIAN MACHINE SHOP,"

which will be devoted exclusively to the interests of machinists, machinery users, foundrymen, and workers in the metal trades generally.

The new paper will be published in popular magazine style, at $1 per year, and will amply illustrate the latest developments in modern machinery and shop practice. Our readers will oblige by making this announcement known to their friends who may be interested and who will desire to have a Canadian paper devoted to their particular needs. We do not desire to displace the circulation in Canada of such of our esteemed contemporaries as the American Machinist, Machinery, the Model Engineer, and other excellent British and United States publications. We rather desire to see these ably conducted journals more extensively circulated, but feel sure that the addition of a thoroughly Canadian journal will be a useful adjunct in giving fresh information, and affording a valuable record of Canadian progress in the field. We shall be glad to receive the names of any subscribers for the "Canadian Machine Shop" from among the readers of the Canadian Engineer and shall take pleasure in sending a sample copy to them or any of their friends on request. We desire to enter upon our list as many as possible to start with the first number.

In conclusion we heartily wish our readers a merry Christmas and a happy and prosperous New Year.

THE BELL TELEPHONE COMPANY AND THE MUNICIPALITIES.

The decision of the Privy Council in the case of the Bell Telephone Company and the city of Toronto is a serious blow to the rights of municipalities. That any corporation should have the right under a Dominion Act to use the streets of Canadian cities and towns for the purpose of earning dividends for private stockholders, without adequate compensation for the privilege, is a position which should not be tolerated by the people. We are glad to note that Toronto has already taken action with the object of bringing the united pressure of the municipalities to bear upon the Government to amend the law in this respect. We are not, however, very sanguine as to the success of this policy. Experience in other matters, such as the exclusion of municipal and independent telephones from the railway stations at Fort William, Port Arthur, and other places, teaches that the monopoly generally emerges the victor in any agitation to curtail its rights. Only one means exists by which to secure to the people of Canada their rights in this, and other respects, and that is, break the monopoly by the establishment of municipal, or independent telephone systems under the control of the local authorities. In this connection we regret the lack of stability on the part of several municipal councils in their dealings with independent companies applying for competitive franchises. It is a matter of record that many aldermen who start out, at the beginning of an agitation for telephone competition, enthusiastic supporters of the movement invariably have a too willing ear for "Bell" arguments, and when a final vote is taken they are found on the side of the monopoly. In other cases all kinds of reasons are set forth to secure delay, or such onerous conditions are framed as effectually shut out any

chance of competition. The result of all this is that the "Bell" in the end generally succeeds in retaining undisputed possession of the field. This ought not to be and aldermen with a sincere desire to protect the people's right to control their own property, and secure cheap and efficient service, should give no heed to any arguments which have for their object the postponement of the introduction of competition. In every case such arguments, no matter by whom advanced, if traced to their original source will be found to be creations of the "Bell" monopoly.

Municipalities who fail to encourage the growth of telephone competition, still further strengthen a monopoly which every year will acquire a tighter hold upon the people who will become more and more powerless to get back their rights which have been voted away by the men whom they elected to protect them.

We note with satisfaction that there is an inclination on the part of the Government to acquire the long distance telephone lines, and while we sincerely hope the time is not far distant when this proposition will be an accomplished fact, we are inclined to the belief that the day when the telephone trunk lines will finally pass out of the hands of the Bell Telephone Co., is a long way off. In the meantime there is a danger of municipalities being urged to delay action in dealing with local telephone matters, on the plea that they had better wait until the Government take action in regard to the long-distance system. On the other hand we are convinced that there is no possibility of Government ownership of the telephone trunk lines until the need for such action is made apparent by the establishment of independent local systems in various parts of the Dominion. It is therefore to be desired that the municipalities will unite in a vigorous effort to secure the building up of independent telephone systems, and will give all reasonable encouragement and assistance to bona-fide companies seeking franchises on fair terms, that is, where municipal ownership is not considered desirable.

The people should give no quarter to a company that openly defies the municipalities, under cover of a Dominion Act, and should further refuse to recognize the principle of granting exclusive franchises to a monopoly, in return for a payment, not for the privilege of using the streets, but to enable it to charge telephone users rentals very much in excess of those for which independent companies are willing to furnish a better service.

SMELTING BY ELECTRICITY.

Of the special reports issued by the Dominion Government during the year now closing, the most important is that of the commission sent to Europe to investigate the subject of smelting by electricity. A synopsis of parts of the report appears elsewhere; and we hope to refer to other aspects of the question later on.

We share the optimism of Dr. Haanel as to the utility of the electric furnace in metallurgy, because every week sees some advance made by inventors in overcoming the drawbacks that have been encountered in the various processes that are going through the evolutionary stage. There are situations in Canada that appear to be specially suited for putting the electric furnace into operation, and already some Canadians at Ottawa and Peterboro are ready to go on record as pioneers in this field. They will be leaders in a field that promises great things for a country like Canada with its colossal water-powers; they may even be financially successful at the start, which is not the good fortune of most pioneers.

If we take the present condition of the iron, steel, and other metal industries, we find that the countries which have been most successful have had good supplies of workable ore and cheap coal as well as cheap transportation between the localities producing the ore and those producing the coal. It is seldom that the ore and coal lie close together as they do in parts of Nova Scotia and British Columbia. Ontario and Quebec, for instance, have various ores of good quality and in good supply, but they have no coal as yet discovered in large veins. Hence these provinces have not developed in smelting as they might have done with cheap supplies of coal. But here nature and science have at last joined to make good the defect, and the success of electric smelting means a new industrial era for these and other provinces. The big water-powers are equivalent to so many coal mines and wherever these water-powers can be developed cheaply and are situated convenient to water transportation or cheap rail transportation, we may expect more or less of these industries to arise in the near future according to the enterprise of the people or their local advantages in other respects. These developments may take unexpected turns in various parts of Canada, especially when combined with the electro-chemical industries, which afford another vast field for the employment of our great water-powers. Looking thus at a large water-power as equivalent to a coal mine we may soon see cities arising in the midst of northern forests where water-falls have been vainly calling throughout the centuries to have their might displayed in harness.

It should be realized, however, that the electric furnace as now being developed cannot do every kind of smelting. It can already do some things better than any other kind of furnace. In the production of ferro-alloys, its success is already undeniable. In Italy, Switzerland and Alpine France, where fuel is dear but water-power abundant, its application has made great progress. In fact the electric furnace has already been the means of flooding the market with these commodities and other uses have to be sought. Diversifying the product of the electric furnace is now the problem there, but as pointed out by writers on the subject, this only follows the history of metallurgy by coal and coke, where the blast furnace is devoted to pig-iron, the puddling furnace to wrought-iron, the crucible furnace to special tool steel and the Bessemer furnace to its particular grades of steel. The refining of blast furnace pig-iron by the electric process has advantages over the present method. Starting with hot metal direct from the blast furnace the temperature is raised and maintained more easily because of the higher electrical resistance of hot iron. The production of steel by the electrical process seems more promising than the direct reduction of iron ores, one difficulty in the latter work being the designing of a furnace of sufficient capacity. Such difficulties may be overcome in time.

In a paper read before the recent Foundrymen's Convention at Philadelphia, P. McN. Bennie draws the following conclusions as to the application of the electric furnace to metallurgy and to foundry practice:—

"It will be seen that the electro-metallurgy of iron and steel has already left the domain of the laboratory and experimental plant, and taken on the serious aspect of an established industry. The electric furnace has its limitations, which it would be well to bear in

mind. Even its most ardent advocates do not consider it a menace to the older methods, but rather as a new and useful adjunct to present metallurgical practice. It should be noted that while some processes are designed to perform the direct reduction of iron ores, the general tendency is to use the electrical energy for production of steel, and particularly as a refining agent in treatment of pig iron and scrap. For this field of usefulness, the electro-refinery seems destined to occupy a permanent place in the art.

When we shall witness the combination of the blast furnace for cast iron, the Bessemer converter for common steel, and the electrical refinery using energy generated from waste blast furnace gases, making higher grade steels, then industrial metallurgy will have attained the high-water mark in the utilization of the heat energy of coal. In attacking the older art from the crucible steel standpoint, electro-metallurgists are undoubtedly hitting at the weakest spot. In the application of the electric furnace to foundry practice, it would be possible to arrange an electrical refining furnace so that it could use the product of any one or all of the cupolas. With the furnace body in the form of a ladle, placed upon a carriage, suitably counterbalanced, and able to swing free in a circle, it may receive its charge and then be placed under the arrangement for carrying the electrodes. By lowering the electrodes, turning on the current, refining may be carried out as previously described in several processes. Without using excessive currents, liquid iron may be converted into steel of good quality. This may suggest to some of your enterprising foundry managers ways of employing their full capacity at all times; to improve the quality of their castings; to convert a portion of the product into steel. For a small cost, a foundry arranged for the manufacture of cast iron could undertake steel castings and augment considerably its sphere of commercial activity."

HOW NOT TO GET CANADIAN TRADE.

The Monetary Times has published a pamphlet under the title of "Dishonest representations—a remonstrance against untruthful statements made in England in connection with Canadian trade." This pamphlet reproduces articles that have appeared from time to time during the past three years in the Monetary Times exposing the methods adopted by the travelling agent of two Montreal commercial journals in obtaining advertisements from British firms who are seeking trade in Canada. One of the schemes adopted by this canvasser was to claim that the paper he represented was subsidized by the Dominion Government. The attention of the Canadian Secretary of State was called to this matter, but it does not appear that any steps were taken until quite recently to put a stop to these misrepresentations, though the Under-Secretary of State denied that his department ever authorized its name to be used even as "a reference" in behalf of one of the papers referred to. A letter from the Under-Secretary to that publisher asking for the name of the official alleged to have given authority for the "reference" remained unanswered. The Canadian Engineer has been in receipt of letters from time to time from British firms who appear to reason, rather illogically, that because they have been disappointed in one advertising transaction there is no use in trying to do business in Canada through advertisements. A correspondent of "Commercial Intelligence" deals with this subject, and pokes fun at the readiness with which British firms have placed advertisements in certain journals "masquerading as trade papers," when their names are absent from the pages of the reputable papers in Canada devoted to their particular line of trade. Imagine, for instance, a coterie of leading British boot and shoe manufacturers spending hundreds of pounds in advertising British-made footwear in Canada, or furniture manufacturers pushing English-made goods of the common class, when Canadian furniture and boots and shoes are so much cheaper that thousands of dollars worth are shipped every year to the Old Country.

These mistakes of British merchants and manufacturers are not serious in themselves, but they are important as disclosing a condition of apathy in regard to trade opportunities in Canada, and of ignorance of the trade conditions now existing in this country. Why is it that, as a rule, we do not find United States firms making the same mistakes in placing their advertisements in Canadian papers? Yet United States firms advertise ten times as much in the trade papers of Canada as British firms, and the striking fact is that in many lines they are taking a proportionate amount of the orders placed by Canadian houses. Regret it as many of our people do, it must be confessed that our United States neighbors understand Canadian temperament better than our British cousins do, and keep themselves in better touch with us, and no clearer proof of this is needed than the methods adopted by the two peoples in cultivating Canadian trade.

—Now that a large supply of electric power will soon be on the market at Niagara Falls, we shall expect to learn of electricity being turned to account to a surprising extent by the farmers of Ontario, especially in the Niagara peninsula to begin with. What has happened in some rural districts in the Western States may be taken as a forecast of developments in Canada. A notable instance briefly described elsewhere is the successful attempt made by the farmers of Kane County, Illinois, to supplant horse, hand and steam power by electricity in carrying out all the operations of the farm. The current is switched from the electric railways and is made to operate pumps, creameries, feed choppers, threshers, fanning-mills, saws, churns, water storage systems, and in fact perform almost all the work hitherto done by horses or steam engines. In a report to the Chicago Tribune these farmers state that the cost of electric power is from 40 to 60 per cent. less than manual or horse labor. The success of these experiments and the remarkable extension of the use of the telephone on the farm will mean a revolution not only in the methods of farming but in the social condition of the farmers. The farmer and his wife and children will no longer need to lead solitary lives. In a few minutes they can learn the price of produce in their market town, or the substance of the foreign news, or again have a social chat with their neighbors. With electric power to ease the strain of the heavier labor of the farm, rural life will have positive attractions to many people now toiling hard in ill-ventilated factories in cities. For a number of decades, "Back to the land" has been the vain appeal of philosophers who have realized the evils and drawbacks of city life; but electricity may soon accomplish a change which neither legislation, philosophy, nor the eloquence of patriots has effected in keeping the boy or girl on the farm or bringing him back after he has adventured into the city.

SMELTING BY ELECTRICITY.

The commissioners sent to Europe by the Dominion Government to investigate the status of the electrical reduction of ores and the making of steel, have sent in their report, which makes a volume of 221 pages, with several plans and diagrams. As mentioned in previous references to the subject, the commission was composed of Dr. Eugene Haanel, Superintendent of Mines, working under the Department of the Interior; C. E. Brown, assistant works engineer of the Canadian General Electric Co., Peterboro; M. Nystrom, draughtsman. In England these were joined by F. W. Harbord, who accompanied the commission as metallurgist.

In the electrical production of pig iron, the Héroult process at La Praz, France, and the Keller process at Livet, France, were investigated; and in the manufacture of steel by electricity they examined the Kjellin process at Gysinge, Sweden, the Héroult processes at Kortfors, Sweden, and at La Praz, and the Keller process at Livet. There is also a report on the Stassano process at Turin, Italy, though through an accident that furnace was not in operation when visited. Other new patents for electrical smelting processes are referred to in the report.

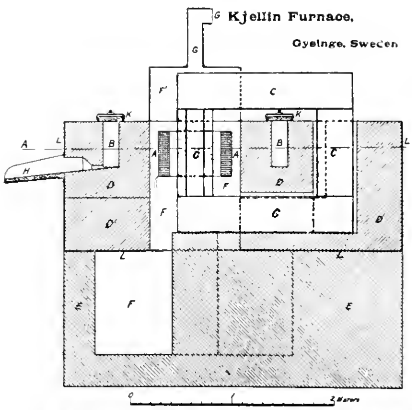


Fig 1

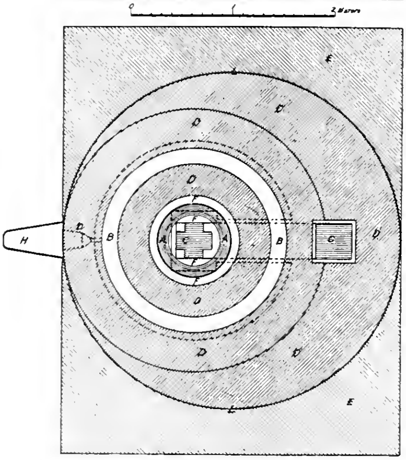


Fig 2

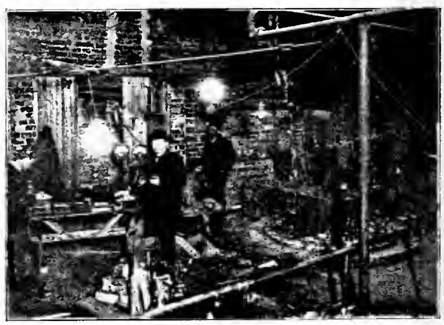
Section A B

At the Gysinge works, steel of superior quality is made by the smelting together of charcoal-pig and scrap in electric furnaces of the induction type, i.e., furnaces without electrodes. The process does not permit the purification of the materials entering into the composition of the steel produced, the quality of the steel depending entirely upon the purity of the component materials employed. The process, therefore, corresponds to the crucible steel process, but has certain advantages over the latter, in that the melted material is at no time during the operation exposed to gases, which absorbed, deleteriously affect the quality of the product; moreover, the absence of electrodes, employed in all other classes of electric furnaces, avoids contamination of the molten material with the impurities which may be contained in the electrodes.

The furnace, of 225-h.p. capacity, is of the induction type, corresponding to a step-down transformer. Fig. 1 represents a vertical section through the tap-spout, and Fig. 2 a horizontal section through A B. The primary A A Fig. 1 consists of a coil of insulated copper wire wound about one leg of the magnetic current C C C C. The secondary is formed by the charge contained in the annular grove B B. To the primary an alternating current of 90 amperes and 3,000 volts is delivered. This current induces in the charge forming the single turn of the secondary, according to Mr. Kjellin, a current of 3,000 amperes at 7 volts. The conversion of electric energy due to the resistance of the charge takes place, therefore, in the substance of

General View of Kjellin Furnace.

the charge. The furnace consists of a cylindrical iron casing, L L, partly closed at the base, resting upon the brick foundation E E. The casing is lined with firebrick D′ D′, and the portion D D (as shown in Figs. 1 and 2) is filled in with the exception of the annular grove B B, and the space F with magnesite or silica brick, according as a basic or acid lining is required for the grove, which forms the melting space or crucible. The space F F, surmounted by the iron cylinder F′, to which the pipe G is attached, serves the purpose of cooling the primary by the draft of air passing through it. In addition to the air draft, water circulation is employed to keep down the temperature in the space occupied by the primary. K K are covers for the annular crucible, and H the tapping spout. The upper part of the furnace is at the same level as the working



Top View of Kjellin Furnace.

floor and the charging is effected by simply removing the covers K K, and putting in the material. Since the heat is produced in the metal contained in the annular crucible, the slag which has formed is at a much lower temperature than in other steel furnaces, and as a consequence the workmen suffer little from the heat.

The following figures, which could not be determined by the commission, relating to the efficiency of the furnace are given by Mr. Kjellin: From a series of trial runs, the production with this furnace averaged 4,100 kgs. in 24 hours, with a power of 165 kilowatts, or 225 electric horse-power. The loss of heat by radiation, transformation, etc., at a temperature of 1,400 deg. C., amounted to 80 kilowatts, this amount of energy

being required to keep the temperature constant at 1,400 deg. C. The temperature of the fluid metal at tapping is from 1,600 deg. to 1,700 deg. C. The cost of a furnace of this type of 600-h.p. is, according to Mr. Kjellin, about $4,000.

Since the measurements of the absorption of electric energy constituted the most important factor in ascertaining the cost of producing steel by this method, and since there was no guarantee of the accuracy of the electric measuring instruments employed at the works, standard instruments were rented from David Bergman, consulting engineer in Stockholm, and placed in the circuit. Mr. Brown reports for an absorption of electric energy per ton of product of 0.116 and 0.145 electric horse-power years respectively. Mr. Harbord reports the estimated cost of steel by the Kjellin process to be $34 per ton of 2,000 lbs.

The capacity of the furnace is comparatively small, but for a larger plant Mr. Kjellin states that three furnaces of the pattern now used might be joined into a compound furnace, and supplied with a three-phase alternating current. This would treble the capacity and reduce the wages, since the number of workmen now employed in operating the one furnace could attend to all three.

Samples of the steel produced and of the materials employed were taken and shipped to England, to be tested as to quality and composition.

The following figures on which the cost of power per electric horse-power year, delivered at the furnace, is based, were furnished by Mr. Kjellin.

Cost of hydraulic canal	$22,000
Cost of power house	10,000
	$32,000

The quantity of water which can be delivered by the canal at low water is 22 cubic meters per second. The head is $3\frac{1}{2}$ meters. Allowing an efficiency of 75 per cent. for the turbines, the available horse-power is 770.

225 horse-power are delivered to the furnace. Losses in generator, exciter and line, 40-h.p., a total of 265.

Part of the cost of power-house and canal to be charged to power for electric furnace is	$11,000
Cost of turbine	1,900
Installing turbine	500
Generator and exciter	5,850
Transmission line	1,000
Switchboard and instruments	600
	$20,850
10 per cent on first cost for interest, depreciation, repairs, taxes, insurance, etc.	$2,085
The part of operating expenses which is chargeable to electric furnace	500
	$2,585

Cost of 225-h.p. delivered to electric furnace is $2,585, or $11.50 per electric horse-power year.

Mr. Harbord, in his report on this furnace, says: "In my opinion, the furnace would require considerable modifications before it could be conveniently used for the manufacture of mild steel to compete with the Siemens furnace, as the difficulty of removing the whole of the slag, while retaining a small portion of the metal in the furnace, would, I fear, be considerable, and I anticipate that repairs could not be so readily effected if the walls were badly cut by the slag, as in the case of an ordinary Siemens furnace. Mr. Kjellin has, however, shown so much ingenuity in surmounting the difficulties in connection with the manufacture of high carbon steel, that, given the opportunity to experiment with a furnace on a reasonable scale, it is quite possible that he may be able to overcome these difficulties, and make the manufacture of mild steel a commercial success. The process, as at present worked, is admirably adapted for the highest class of steel from pure materials and the only objection to it, is that it is limited to these pure materials and can only be used where they are obtainable. I do not think in its present stage of development it is adapted to treat ordinary pig iron and miscellaneous scrap of more or less irregular composition, as the complete elimination of any impurities present could not always be relied upon. Under the special conditions existing at Gysinge and in some other places, it is capable of doing most excellent work and is a most efficient and economical metallurgical appliance. There seems no reason why the size of the furnace should not be very considerably increased, whatever difficulties there may be being electrical, rather than metallurgical, and with furnaces of 5 to 10 tons' capacity the labor costs would be very greatly reduced. Five men and one boy could do all the necessary work if they had a little assistance in charging, on a five-ton or even a ten-ton furnace without being in any way overworked, and this would at once reduce the cost of labor by nearly five to ten times, according to the size adopted, so that with a fair-sized furnace the cost of labor in Canada, notwithstanding the much higher rates paid, might be actually less than at Gysinge."

In another issue we hope to give some account of the other furnaces.

GENERAL CONCLUSIONS.

The following are the conclusions arrived at by Mr. Harbord, as a result of his investigation into the metallurgy of the electric production of steel, and the electric reduction of iron ore:

1. Steel equal in all respects to the best Sheffield or crucible steel can be produced, either by the Kjellin, Héroult, or Keller processes, at a cost considerably less than the cost of producing a high-class crucible steel.

2. At present, structural steel to compete with Siemens or Bessemer steel cannot be economically produced in the electric furnaces, and such furnaces can be used commercially for the production of only very high-class steel for special purposes.

3. Speaking generally, the reactions in the electric smelting furnaces as regards the reduction and combination of iron with silicon, sulphur, phosphorus and manganese, are similar to those taking place in the blast furnace. By altering the burden and regulating the temperature, by varying the electric current, any grade of iron, grey or white, can be obtained, and the change from one grade to another is effected more rapidly than in the blast furnace.

4. Grey pig iron, suitable in all respects for acid steel manufacture, either by Bessemer or Siemens processes, can be produced in the electric furnace.

5. Grey pig iron, suitable for foundry purposes, can be readily produced.

6. Pig iron, low in silicon and sulphur, suitable either for the Basic Bessemer, or the Basic Siemens process, can be produced, provided that the ore mixture contains oxide of manganese, and that a basic slag is maintained by suitable additions of lime.

7. It has not been experimentally demonstrated, but from general considerations there is every reason to believe, that pig iron, low in silicon and sulphur, can be produced, even in the absence of manganese oxide in the iron mixture, provided a fluid and basic slag be maintained.

8. Pig iron can be produced on a commercial scale at a price to compete with the blast furnace only when electric energy is very cheap and fuel very dear. On the basis taken in this report, with electric energy at $10 per E.H.P. year, and coke at $7 per ton, the cost of production is approximately the same as the cost of producing pig iron in a modern blast furnace.

9. Under ordinary conditions, where blast furnaces are an established industry, electric smelting cannot compete; but in special cases, where ample water-power is available, and blast furnace coke is not readily obtainable, electric smelting may be commercially successful.

It is impossible to define the exact conditions under which electric smelting can be successfully carried on. Each case must be considered independently, after a most careful investigation into local conditions, and it is only when these are fully known that a definite opinion as to the commercial possibilities of any project can be given.

Nothing requires to be added to Mr. Harbord's conclusions regarding the electric production of steel; in reference to the production of pig, however, it must be pointed out that the results obtained at Livet were results of experiments in furnaces not specially designed for the production of pig iron ore. With the improved furnace, permitting, on account of the higher column of charge, a more effective use of the heat of the resulting gases, and of the reducing power of the CO

evolved, a much better figure than the one obtained would result.

The modern blast furnace, and the different methods for the making of steel as at present employed, are the result of a hundred years of experience, and have reached their present perfection through many modifications, which, in many instances, were accepted and introduced into practice only after much hesitation and opposition. The process of the electric reduction of iron ore must yet be regarded as in the experimental stage; in fact, no plant exists at the present time where iron ore is commercially reduced to pig by the electric process. The more remarkable, therefore, it appears, and the more gratifying it is regarding the future of electric smelting, that experiments made off-hand, so to say, in furnaces not at all designed to be used for the production of pig should give a figure of cost which would enable the experimental plant employed to compete with a blast furnace in regions where electric energy can be had for $10 per E.H.P. year, and where coke is quoted at $7 per ton.

I am credibly informed that the water-power at Chats Falls can be developed at a cost to produce an E.H.P. year at the rate of $4.50. There are probably many water-powers favorably situated as regards good bodies of ore in the Provinces of Ontario and Quebec, which can be developed as cheaply. When such power is owned by the company intending to use it for electric smelting, and peat coke or briquetted charcoal, made from mill refuse (in the Ljungberg continuous kiln refuse wood is burnt into charcoal at 33 per cent. less cost than in heaps and with 22 per cent. higher yield), which would probably not cost more than $4 per ton, is employed for reduction, the cost of two of the heaviest items entering into the cost of producing pig by the electric process is reduced to one-half.

When it is considered that the electric process is applicable also to the smelting of ores, such as copper, etc., and that the furnaces are of simple construction, the temperature available 1,000 deg. C. above that of the blast furnace, and the regulation of the heat supply under perfect control, it is reasonable to expect that the near future will witness great strides in the application of electric energy to the extraction of metal from its ores, and that familiarity with handling large currents and experience gained in electric smelting will result in solving the difficulties encountered in the smelting of ores, which up to the present time have proven refractory to all economical processes known.

RAILWAY NOTES.

The Grand Valley Electric Railway ran their first car from Brantford to Galt on November 15th.

The Scarboro Electric Railway, Toronto, is being extended to Highland Creek, fourteen miles from the city.

The Government has secured from the Nova Scotia Steel Co. the right of way for the extension of the Intercolonial Railway to Sydney Mines.

The Grand Trunk is not at present considering the building of a third track from Toronto to Hamilton, as was reported some time ago.

The Canadian Pacific is negotiating for the Bruce Mines and Algoma Railway, owned by a Buffalo syndicate.

The Preston and Berlin Street Railway Co. has installed a storage battery of about 300-h.p. hour capacity. The battery was supplied by the Gould Storage Battery Co., Depew, N.Y.

Rhodes, Curry & Co., Limited, have received a contract from the Intercolonial Railway for the building of a roundhouse at Truro. The building will cost in the vicinity of $110,000.

The C.P.R. recently made a contract to carry 10,000 tons of English spiegel from Liverpool to Sault Ste. Marie, the first contract of its kind made by a Canadian company. The spiegel has been purchased by the Algoma Steel Co.

The first twenty miles of the International Railway from Campbellton, N.B., have been completed. The line is to run west through the northern part of the province to the St. John river. Thomas Malcolm is the contractor in charge of construction.

The C.P.R. will build a line from Stratford to Conestoga, connecting the latter place with the Guelph and Goderich line. It is stated that the company will build a branch from Goderich to Stratford, paralleling the Grand Trunk. A line south from Goderich, making connection with Chicago, is also proposed.

The C.P.R. has about finished the new piece of track between Wild Rice and Emerson, Man., which will give it, in connection with the "Soo" line, a direct air line between Winnipeg and St. Paul, a distance of something like five hundred miles. This work was carried out by Mr. William Whyte, second vice-president.

It is expected that the portion of the Halifax and Southwestern Railway, between Halifax and Bridgewater, N.S., will be in running order this month. The rails are laid to Liverpool, but it is not likely the line will be operated till spring. The bridgework of this railway is divided between the Canada Foundry Co. and the Dominion Bridge Co.

A number of contractors are now figuring on the work of double tracking the C.P.R. main line between Winnipeg and Fort William. The date for the opening of the tenders has not yet been fixed, but it is the intention to try and begin work this fall. The plans and specifications for the rock and earth cuts and the fills have been in the hands of the company's engineers for some time past, and there will be no delays when once construction has started.

The new railway engineering department of McGill University, Montreal, is now being organized. It will have a council of administration composed of Charles M. Hays, president of the Grand Trunk Pacific Railway; Sir Thomas Shaughnessy, president of the Canadian Pacific Railway; E. B. Greenshields, R. B. Angus, and C. J. Flett. These gentlemen will determine upon the curriculum, but their chief regular functions will be of an advisory character.

An automatic brake, designed to prevent engineers running their trains past closed semaphores, has been invented by James Doyle, U.S. customs officer at Niagara Falls. The brake is operated by a trip, which, when the semaphore is closed, strikes a projection on the brake of the passing engine. A successful test was recently made in the Niagara, St. Catharines and Toronto Railway. It is said that the brake costs only about $30 per appliance.

A company, known as the Toronto and York Radial Railway Co., has been organized with chief officers as follows: President, William Mackenzie; general manager, W. M. Moore; assistant superintendent, John McCarty. The company is an amalgamation of the Metropolitan, the Mimico, and the Scarboro electric railways, and is independent of the Toronto Railway Co. The new company controls nearly fifty miles of railway. J. W. Moyes has been retained by the company as superintendent of the Metropolitan.

Railroad development in Prince Edward Island has taken quite a jump in the last few months. A new line of railway from Emerald on the P.E.I. Railway, through the New London district to the North shore, a distance of thirteen miles, has been surveyed. Two preliminaries were run. This road will likely be built next summer and will open up an old, thriving agricultural settlement, badly in need of railway accommodation. A survey of a railway from Souris, eastern terminal of P.E.I. Railway, to Elmira, near East Point, a distance of 13¼ miles, through a partly wooded country, was made in October by J. Ruel, chief; J. A. Macdonald, S. Can. Soc. C.E. and J. McLean. This road has been agitated by the people of that section for more than twenty years, and is to be built the coming year. The location survey of the Montague-Cardigan branch line was recently completed by A. T. Wilson, H. T. Emmerson, and J. A. Macdonald, engineers, and bids called for immediate construction. Mr. Willard Kitchen has secured the contract, and work will go on through the winter. The preliminary line for this road was run last winter by H. J. McKenzie, chief, with Messrs. Black and Owen, assistants. An amount of money had been placed in the estimates last session by the Dominion Parliament for the running of a preliminary line from, at, or near O'Leary, P.E.I. Railway, to the West Shore, but the line has not been yet run. The contract for Vernon River branch has been awarded to Willard Kitchen.

MUNICIPAL WORKS, ETC.

The waterworks being installed at Gananoque have been opened.

Brantford will vote in January on a by-law to raise $62,000 for an underground drainage system.

Stratford city council will probably submit a by-law to the voters in January for the raising of $50,000 to be used in extending the water mains and improving the fire protection.

The asphalt plant owned by the City of Winnipeg was burned November 6th. The loss will be over $20,000. All work on the asphalt street pavement will be stopped for the year.

Windsor has experienced a building boom this year. Nearly $500,000 has been spent in buildings in that city during the year, while about half that amount has been similarly spent in Walkerville.

St. Thomas has reached an agreement with the Gas Company without requiring the services of the arbitrators who were appointed. The price to be paid for the gas, electric light and power plant has been fixed at $196,000.

Dundas will repair the town dam, which has been damaged greatly by the spring freshets of the past two years. The cost is estimated at $1,500. R. L. Latham, of Hamilton, is preparing plans.

Recent visitors to New Liskeard report that that town is much improved in appearance. A better class of houses is going up, and everyone appears to be prosperous. The town recently purchased a fire engine and a supply of hose.

Toronto is now laying a six-foot water conduit across the bay, at a cost of $175,000. Plans are being prepared for an eight-foot tunnel under the bay, which is to be constructed after the completion of the conduit. The tunnel will cost, it is estimated, about $350,000.

Ottawa recently asked the Ottawa Electric Railway to set a price on the plant and franchise, and the figure quoted was $2,500,000, and the assumption of a bonded indebtedness of $500,000. The price is regarded as reasonable, but is thought by many to be beyond the city's finances.

The offer of Snow & Barbour, a Boston firm of engineers, to report on the best method of increasing the water supply of Halifax, was accepted by the city council, but was vetoed a a week later by the Mayor, on the ground that sufficiently competent engineers could be found in Canada. A legal contest is said to be probable.

Westmount, Que., will on December 3rd, take a vote on a by-law empowering the town to acquire property for supplying electric light. It is thought that the town can supply light at about two-thirds of the price now charged by the company. The contract with the Montreal Light, Heat & Power Co. expires in December, 1906. The expense of installing the municipal plant will be met by a loan of $225,000.

MINING MATTERS.

A new gold vein has been discovered in Guysborough County, Cape Breton, three miles from the Richardson gold mine.

The German-American Co., recently organized, has secured 2,000 acres of mineral land near Lake Rideau, Ont., and is shipping phosphate to Germany.

A new plant, costing $50,000, is being installed in the Lower Cove (N.S.) coal mines. The number of hands employed will be increased from 150 to 300.

Molybdenum has been found near Black Donald, Renfrew County, Ont. Representatives of United States capitalists have purchased the property on which the discovery was made.

The Minto gold mine in the Michipicoten district, has been sold to Reading, Pa., capitalists for $108,500. The sale is regarded locally as an indication of the revival of interest in gold mining in that neighborhood.

Corundum found in Methuen Township, Peterboro County, has recently been assayed by Prof. Wilmot, of the Geological Survey, and declared to be the finest ever assayed by the Survey. It has a specific gravity of 3.99.

The iron range in B[illegible] Haileybury, has been [illegible] Provincial Geologist, and is [illegible] other ranges in the northern [illegible]

A company [illegible] Nfld., have struck [illegible] quality [illegible] 30 feet. Four hundred tons of ore [illegible] and it is expected that 4,000 tons will be ready [illegible] the spring.

The deposits in the neighborhood of Cobalt [illegible] station on the Temiskaming Railway [illegible] bury), have panned out well the past summer, about $2[illegible] worth of cobalt, nickel, silver and arsenic having been shipped to New York for treatment. These deposits were discovered about a year ago.

The Sapphire corundum mine, in Peterborough County, which has been closed owing to the attempted frauds of Ernest Terah Hooley, who sank thousands of dollars of English capital in the mine, will be reopened and operated again. The company will be composed largely of local capitalists. L. A. Morrison, of Toronto, formerly of Peterborough, is at the head of the organization.

W. E. H. Carter, of the Bureau of Mines, made an extended trip to Northern Ontario last month. He reports activity in the mining industry. The Huronian Co., developing the water-power at Turbine, expect to deliver 11,000-h.p. to the Canadian Copper Co. next year. The Copper Company has a blast furnace in operation in connection with the converters. The Creighton mine has easily supplied sufficient ore to the works so that the other mines have closed down. High grade material has been produced from matte, having 80 to 82 per cent. combined nickel and copper, and at lower cost than in any previous period. The Massey Station copper mine has now got the Elmore oil plant satisfactorily concentrating ore. The Herminia copper mine adjoining the Massey is also being actively developed. A shaft has been sunk to a depth of 200 ft. to the vein. The Shakespeare gold mine is putting up a five-stamp mill, and ore will be treated shortly. Another adjoining mine in course of development is the Avon. On the Algoma Central, north of the Sault, the Williams iron mine has struck in lower levels, 200 feet deep, several bands of high grade hematite ore, totalling 23 feet of clean ore, and an additional ten feet or more of second grade. This is an entirely new iron area, and if the bodies prove to be continuous, may develop into an important field. North of Temagami there are two promising prospects, one for iron pyrites (sulphur ore), and another for arsenical pyrites. There are a number of other iron pyrites and arsenical properties in the district which are likely to be exploited next season.

MARINE NEWS.

The whaling steamer, Har[illegible] Gr[illegible], with a crew of twelve men, from Norway for St. John's, Nfld., now nearly a month overdue, is given up for lost.

Davis & Sons, of Kingston, have received a contract to build an $8,000 steamboat for W. Thompson, Orillia. It will be eighty-two feet long and sixteen feet beam.

Next season the C.P.R. will purchase at least two new boats for the Atlantic service, and the Pacific fleet will be strengthened by the addition of two, if not three, new steamers.

The Hamilton Steamboat Co. has declared a dividend of ten per cent., and satisfaction with the season's business has been expressed. The Modjeska and Macassa will be improved and refitted during the winter.

The passenger steamer Ocean, which plied between Hamilton and Montreal, was burned to the water's edge at Port Dalhousie last month. She was 137 feet long, and was built in 1872 at a cost of $30,000. She was owned by the Wentworth Navigation Co., Toronto.

The Germanic, formerly of the White Star Line, and latterly on the American line between New York and Southampton, is now being renovated at Harland & Wolf's yards, Belfast. It is reported that she will come to Montreal next season as a Dominion liner, with the name Ottawa. She will have a speed of 17 knots, with a maximum of 20 knots.

The car ferry, Detroit, for use by the Michigan Central Railway, between Windsor and Detroit, was recently launched by the Great Lakes Engineering Co. She is a screw steamer, with two propellers at each end. She is 308 feet long, and can accommodate 28 standard-size cars. It is expected that she will be in commission before the river freezes over.

LIGHT, HEAT, POWER, ETC.

The wheelpit of the Electrical Development Co., at Niagara Falls, is completely excavated and work on the brick lining will soon commence. Work will be continued all winter.

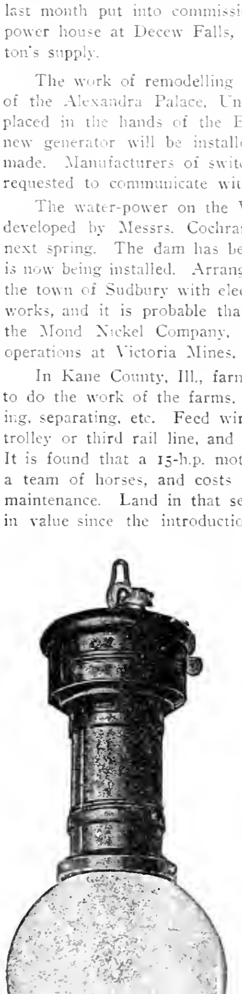
The Canadian Niagara Power Co. has let water into their forebay, and expect to have one of the 10,000-h.p. turbines working early this month.

The Hamilton Cataract Light, Power and Traction Co. last month put into commission two new generators in their power house at Decew Falls, thus adding 13,000-h.p. to Hamilton's supply.

The work of remodelling the electric light and power plant of the Alexandra Palace, University Ave., Toronto, has been placed in the hands of the Electrical Supervision Society. A new generator will be installed and other material changes made. Manufacturers of switch board supplies, lamps, etc., are requested to communicate with the engineer.

The water-power on the Walnapitae river, which is being developed by Messrs. Cochrane & McBittie, will be available next spring. The dam has been completed, and the machinery is now being installed. Arrangements have been made to supply the town of Sudbury with electrical power for light and waterworks, and it is probable that power will also be supplied to the Mond Nickel Company, who are preparing to resume operations at Victoria Mines, west of Sudbury.

In Kane County, Ill., farmers are installing electric motors to do the work of the farms, such as sawing, pumping, threshing, separating, etc. Feed wires are run in from a contiguous trolley or third rail line, and a motor is installed in the barn. It is found that a 15-h.p. motor does the work of a man and a team of horses, and costs about 50 per cent. as much for maintenance. Land in that section is reported to be going up in value since the introduction of electric power.



Arrangements have been concluded whereby the marketing of the products of the Packard Electric Company, Limited, the Crocker-Wheeler Company, and Brown, Boveri & Cie, in Canada, will be looked after by the selling organization of the Packard Electric Co., Limited, of St. Catharines, Montreal and Winnipeg. The Crocker-Wheeler Company are manufacturers and electrical engineers with their works and main offices located at Ampere, N.J. Their line of manufacture includes electrical generators and motors for every industrial, lighting and power purpose. They are American licensees of Brown, Boveri & Cie, of Baden, Switzerland, celebrated designers and manufacturers of alternating current apparatus, whose efforts in this field have brought the alternating current machine to a point of standardization. The reputation for excellence earned by the Crocker-Wheeler apparatus during the past fifteen years, has spread beyond the United States, and it is to better serve their increasing trade in Canada that this arrangement has been made.

On Saturday evening, November 19th, the International Correspondence Schools gave their monthly lecture and entertainment in the Temple Building, Toronto, for the benefit of their students and friends. It has, therefore, been the policy of make these evenings "smokers," but for this occasion the smoke was omitted, and ladies were invited. The large hall was completely filled with ladies and gentlemen. The principal feature on the programme was an illustrated talk on "The Toronto-Niagara Power and Development," given by K. L. Aitken, chief engineer of the Electrical Supervision Society, Toronto.

Results of experiments conducted by William Grunow, Jr.; W. T. Oviatt and R. B. Davis of the Connecticut Railway and Lighting Company, at Bridgeport, last winter to determine the amount of current required to heat a third rail for the removal of sleet have been published and show that with the air at 15 deg. F., the temperature of the rail was raised 19 degrees in 15 minutes; and with the air 21 deg. F., the temperature of the rail was raised 19 degrees in 12 minutes. The energy consumption during these 15 minutes was equivalent to 90 kilowatts, if the heating had been applied to a one-mile length of the same section of rail. A 70-pound T-rail 30 feet long was used and was heated by means of a steel wire carried under the head of the rail and insulated from it by porcelain bushings. Wood protections were employed to shield the rail from wind and to maintain its temperature.

TELEPHONE AND TELEGRAPH.

Toronto is petitioning the Dominion Government to take over the long-distance telephone lines.

The Canadian Machine Telephone Co. will have their service in Peterboro in operation by January 1st.

Brantford City Council has passed a resolution asking the Government to acquire the long distance telephone lines.

Gregorio Pansa, of Naples, claims to have invented a wireless apparatus combining the telegraph, telephone, and telantograph.

The case of Price vs. City of Hamilton to quash the Bell Telephone Co.'s franchise in that city, is to be carried to the Court of Appeal.

The Marconi station at Cape Race, Nfld., has been completed, and works satisfactorily, its efficiency having been tested from a point 100 miles to seaward.

Wendel Shantz, a farmer living near Waterloo, Ont., is agitating the organization of a rural telephone company. It has been suggested that the proposed system might be operated by the county.

It is expected that at the coming session of Parliament, legislation will be introduced to bring wireless telegraphy under Government control. The Imperial Government is asking that this be done in all the self-governing dependencies.

Toronto asked the Stark Telephone Co., the Canadian Machine Telephone Co., and the Canadian Telephone and Telegraph Co. to tender on their own specifications for a telephone franchise. November 30th was the date for receiving tenders.

Brantford City Council has defeated the by-law ratifying a fifteen-year agreement with the Stark Telephone Co., of Toronto. This was due to a feeling on the part of some of the aldermen that the Canadian Machine Telephone Co. should have a chance to tender for a franchise after the completion of their installation in Peterboro.

PERSONAL.

Homer S. Johnson, vice-president and manager of the Penberthy Injector Co., Windsor, visited Toronto last month.

J. W. Platten, who is a native of Port Perry, Ont., has been elected second vice-president of the Lehigh Valley Railroad Co.

The superintendent of construction of the new ship being built at Bucksport, Me., for Lieut. Peary's Arctic explorations, is Herbert S. Newcombe, a native of Hopewell, N.B.

Joseph Sutherland, ex-councillor of Bilston, Staffordshire, England, who recently completed a trip through Canada, remarked: "The resources of Canada are such as to make her a Britain, France, Spain and Russia, all in one. She possesses the iron of Britain, the fruit and salubrious climate of France, the rich minerals of Spain and wheat fields that rival the best in Russia."

A. M. Wickens, chief engineer of the Canadian Casualty and Boiler Inspection Co., spent a few weeks in Manitoba in the interests of his company, returning to Toronto on the 10th ult.

G. T. Jennings has been appointed to a section of the French River Canal survey, which commences operations immediately. Mr. Jennings is the son of W. T. Jennings, C.E., of Toronto.

Frank Forsythe, of Hamilton, late of Berkeley Springs, W. Va., has been appointed factory superintendent for the Peterboro Shovel and Tool Co., recently incorporated. About 100 hands will be employed.

T. Christie, late of the Garlock Packing Co., of Hamilton, Ont., has recently been appointed Canadian representative for the Quaker City Rubber Co., of Philadelphia, Pa., with headquarters in the Carlaw Building, Toronto, Ont.

Engineer W. Blennarhassett, one of the senior engineers on the Fort William division, has received the appointment of travelling engineer on the C.P.R., in charge of all the locomotives on the division. This position was formerly held by the late R. J. Armstrong.

Sheldon T. Bent, who was secretary and treasurer of the Continental Light, Heat and Power Company, and Shawinigan Carbide Company, and who embezzled the sum of three thousand dollars from his employers, was sentenced on November 14th to nineteen months' imprisonment.

Alexander H. Notman, district passenger agent for the C.P.R., at Toronto, died in New Mexico on November 13th. He had a most successful railway career of twenty years, and was one of the most popular railway men in Canada. His place will be taken by C. B. Foster, of St. John, N.B.

J. D. Jones, general yard master for the G.T.R., at Montreal, has been appointed superintendent of St. Clair Tunnel and terminals, in the place of the late A. S. Begg, who met his death in the tunnel accident of two months ago. The position of acting superintendent of St. Clair Tunnel and terminals has been abolished.

J. H. Jewell recently entertained one hundred and fifty guests at dinner on the occasion of the opening of Jewellville post-office, named in his honor. The new village is in Renfrew County, Ont., near Palmer Rapids, and is the scene of the operations of the Corundum Refiners, Limited, of which Mr. Jewell is president.

At the annual banquet of the Canadian Association of Cincinnati last month, an address was delivered by H. G. Tyrrell, engineer, author and journalist, formerly of Toronto and Boston, now chief engineer of the Brackett Bridge Co., of Cincinnati. The subject of Mr. Tyrrell's address was Canada and her Educational System.

The Rumford Medal, presented every two years by the Royal Society to the scientist making the most useful discovery in the realms of heat and light, has this year been awarded to Ernest Rutherford, professor of physics at McGill University, in recognition of his researches in radio-activity. The fund which provides the medals was founded by Count Rumford, in 1796, and among the recipients have been Sir Humphrey Davy, Michael Faraday, James Clerk Maxwell, John Tyndall, and other physicists of world-wide reputation. Professor Rutherford is a native of New Zealand, where he took his M.A. and B.Sc. degrees. In 1894 he went to Cambridge as an 1851 Exhibition scholar, and from there came to McGill University. He was made a Fellow of the Royal Society in 1903. He has published over forty papers on radium, and is considered an authority on the subject, second only to M. and Mme. Curie, the discoverers of the element.

J. M. Bell, M.A., Ph.D., F.R.G.S., who for the past two years has been teaching in the mining and geological departments of Harvard University, has just been appointed geologist to the Government of New Zealand. Dr. Bell has had extensive experience in Canada as a field geologist, having led an expedition for the Canadian Geological Survey to the Mackenzie River and Great Bear Lake, for which work he received the fellowship of the Royal Geographical Society. For two years he was employed by the Algoma Commercial Company of Sault Ste. Marie, and during the past two summers has been engaged by the Ontario Bureau of Mines in the preparation of a monograph upon the Michipicoten iron range. Dr. Bell was born in St. Andrew's, Quebec, in 1877, and educated at Queen's University, and in England, receiving his degree of Doctor of Philosophy from Harvard University. He is a son of Andrew Bell, C.E., of Almonte, and a nephew of Dr. Robert Bell, director of the Canadian Geological Survey.

CALAMITY COLUMN.

Steamer Argo, of Lumsden's Line, was burned at Kippewa, Que. Loss, $15,000.

A special C.P.R. freight was ditched at Melbourne, Man. Eight cars badly smashed. Cause: broken coupling.

Ernest Mann's planing mill, Peterboro, was destroyed by fire. Loss, $10,000; insurance, $4,500. Will resume business.

An emery wheel burst at McClary's new foundry, London, by which George Braund, an employee, was probably fatally injured.

Wm. M. Drader's stave and heading factory, Chatham, was destroyed by fire. Loss, $20,000. One hundred employees are out of work.

T. E. O'Brien's flour and grist mills, at McIntosh Mills, near Brockville, were destroyed by fire last month. Loss, $20,000; insurance, $6,000. Cause unknown.

A collision occurred between a passenger train and an engine on the Grand Trunk at 2 a.m., November 15th, near Merritton. Engines badly damaged, also two cars. Ten persons injured.

The schooner Annie Falconer, owned and sailed by Capt. M. Ackerman, of Picton, Ont., went down in a gale last month, while on her way from Sodus Point, N.Y., with soft coal for Picton. James Sullivan, mate, died of exposure.

The schooner William Crosthwaite was burned to the water's edge while lying at anchor near Whitefish Point, Lake Superior. The crew barely escaped and the vessel is a total loss. Supposed cause: overheated stove in the galley.

A fire in Brockville destroyed a storehouse of the Central Canada Coal Co., also the wringer works and part of the tool works of the James Smart Mfg. Co. Seventy-five employees thrown out of work. Loss about $30,000, mostly covered by insurance. Company will rebuild.

Peter Wood, a builder's laborer, while wheeling a barrow across a beam in the new power-house at Toronto, fell to the basement and was killed. The coroner's jury will enquire whether the builders were guilty of a breach of the by-law for the protection of workmen on buildings.

An eastbound freight train broke in two in the Sarnia Tunnel on November 22nd, and but for the caution of the crew and favorable weather conditions, the disaster of October 9th might have been repeated. A cattle-drover, riding in the van, was overcome, and was revived with some difficulty.

Garnet, the engineer of the electric station, at West Prince Albert, N.W.T., was electrocuted on November 12th. After turning on the lights, he went behind the switchboard for some purpose unknown, and was found holding the connections. Efforts made to restore life were futile, and it is thought that death was instantaneous.

The C.P.R. car ferry Armstrong, plying between Prescott and Ogdensburg, sank on November 1[illegible]th. She had on board two railway cars loaded with iron ore and 100 tons of steel rails. The lashings broke, so the cars ran out through the stern gangway, pulling the stern down till the water got into the hatches and filled the boat. The crew escaped in a life boat.

The Toronto Railway Co. has had an unusually large number of accidents recently, the most serious of which occurred on November 17th, when a car was run into by a Grand Trunk train at the Queen St. East crossing. Three lives were lost, and many persons were injured. The inquest is not yet finished, but the failure of the street-car brakes is thought to be responsible for the accident. J. E. Duval, inspector of accidents, has examined the crossing and says the Scotch dogs should be at least seventy-five feet from the steam railway tracks, instead of thirty feet, as at present.

William Strickland, a carpenter, was killed on Gerrard St., Toronto, on November 22nd by a fragment of a flywheel, which burst in Elias Rogers & Co.'s coal yard, 200 yards away. The stationary engine in the coal yard was hauling a loaded car up the incline, when the governor belt snapped. The portion of the wheel which killed Strickland was seen as a ball of fire flying through the air.

The Scientific American, in commenting on the recent epidemic of railroad disasters, says that the most fruitful cause of loss of life in head-on collisions is to be found in Pullman cars. Their heavy construction, while a protection to their inmates, is a menace to passengers in the lighter day coaches. In rear collisions, on the other hand, the inertia of the Pullmans serves to absorb considerable energy from the colliding train, and thus serves as a protection to cars ahead.

Buffalo has a grade crossing commission, composed of ten members, who are State appointed and unsalaried. Since 1888, when the commission was formed, $10,000,000 has been spent in improving the safety and convenience of level crossings. The commission decides what action is to be taken, and the railway is assessed 50 per cent. of the cost, the city and state each paying 25 per cent. The commission has power to close streets or acquire property, as may be necessary. In the appointment of commissioners, it has been the policy to choose citizens of large landed interests, to check the tendency to lavish expenditure. The Toronto Board of Trade has been investigating the working of the Buffalo Commission, and will advocate the forming of a similar commission in Toronto. By a peculiar coincidence, the representatives of the board were in Buffalo investigating the matter when the disastrous level crossing accident took place in Toronto last month.

Since the accident in the Sarnia Tunnel in October, the tunnel has been examined by the Railway Commission's inspector of accidents, J. E. Duval. He was in company with Mr. Mountain, chief engineer of the Commission, and Mr. Hobson, chief engineer of the Grand Trunk Railway, who built the tunnel. Mr. Mountain afterward left to inspect the Baltimore and Ohio Railway's tunnel, at Baltimore, and the Hudson River Tunnel at New York before making a report to the Commission. Dr. F. T. F. Stephenson, of Detroit, an expert on gases, has examined the tunnel for the G.T.R. Co., and it is said he will recommend forced draft. Third Vice-President Morse recently visited New York to examine the equipment of the Subway Railway. Several electric companies are estimating on the cost of converting the traction in the Sarnia Tunnel and will submit propositions, after which it is expected that the management will decide between forced draft and electric traction.

The Railway Commission's Inspector of Wrecks has presented a report on the wrecks in the country since May 1st last. It may be summarized as follows: May 2nd, G.T.R. pitch-in, South River, Ont.; fireman killed; danger signal disregarded; engineer, fireman and forward brakeman thought to have been asleep.——June 17th, G.T.R. pitch-in, Paris, Ont.; three men killed; danger signal passed.——June 23rd, Intercolonial run-off, Riverdale, N.S.; spread track, due to lateral pressure of heavy engine rounding sharp curve at high speed.——August 1st, G.T.R. pitch-in, Gravenhurst, Ont.; engineer and conductor of work-train disregarded rule under which they were working.——August 31st, G.T.R., head-on, Richmond, Que.; nine killed; criminal failure of conductor and engineer of excursion train to comply with specific rule.——September 1st, C.P.R. head-on, Sintaluta, N.W.T.; five women killed; failure to close switch after a freight; conductor, engineer, and brakeman of freight responsible. The evidence shows that none of these accidents were caused by overwork of employees, and that the greatest loss of life is always in old, weak cars used as smokers and second-class coaches. The commissioners are considering requesting the Attorneys-General of the Provinces to prosecute in every instance where carelessness or disobedience is shown, mere dismissal being insufficient punishment. Since the compilation of the above report, the Commission has investigated the collision at Eastwood, Ont., September 28th, by which five men were killed, and has found that it was caused by a switch being left open by either the conductor or the brakeman, both of whom were killed, and both of whom had been on duty continuously for thirty-two hours. The inspector will make recommendations to the Board with a view of avoiding similar accidents.

CANADIAN CRUISER VIGILANT.

The Dominion fisheries protection cruiser, Vigilant, built by the Polson Iron Works, of Toronto, has been completed, and was recently given a trial trip. Although the speed contracted for was only 16 knots, the boat made 17.46 on her trial run. Captain Spain, of Ottawa, and Inspector Douglas Stevens were on board and were well pleased with the new boat's performance.

A photograph and drawings of the Vigilant are reproduced herewith. The principal dimensions are as follows: Length of water-line, 176 ft.; breadth moulded, 22 ft.; depth from top of keel to top of main deck, 14 ft. 3 in.; draft, 8 ft. The engines are twin screw, triple expansion; cylinders, 13½ and 22 and 36 by 21-in. stroke. There are two Clyde boilers, each 11 ft. 6 in. diameter by 12 ft. 8 in. long; working pressure, 200 lbs. steam. Armament: 4 rapid-fire guns. The boat has flush

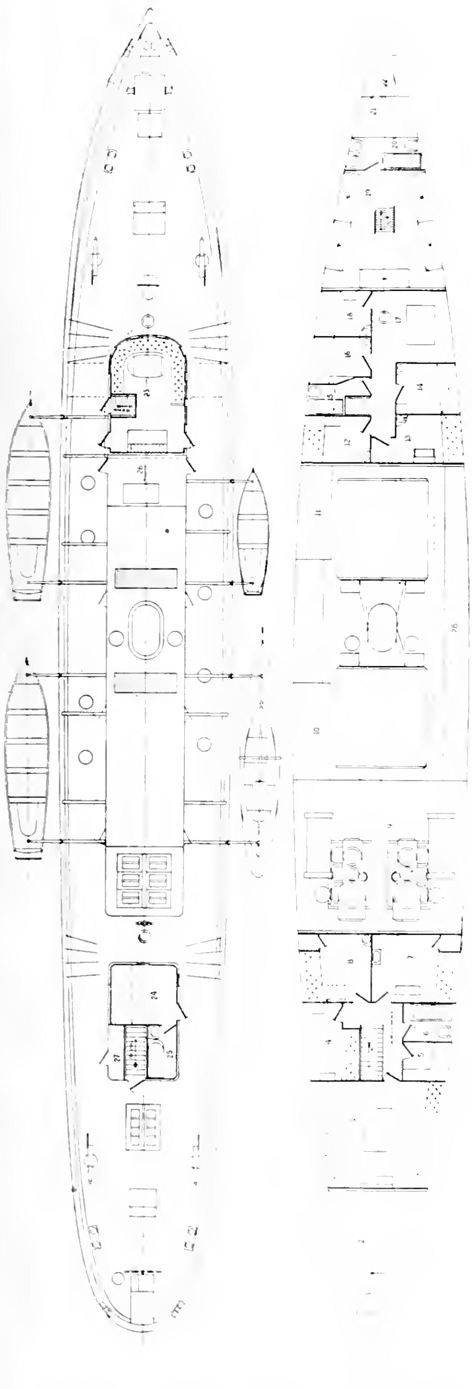
The Vigilant Leaving Toronto Bay.

main deck and bulwarks, having a ram bow and elliptical stern, of similar design to those of the cruisers of the British navy. She has a commodious deckhouse aft of the foremast, containing chart-room, galley and fan room, and also a deckhouse abaft the main mast. The bridge is arranged extending from the forward deckhouse to the ship's side. The vessel is schooner-rigged, with jib-headed foresail and mainsail. She has a complete installation of auxiliary gear, including steam steering gear, steam windlass for working the anchors, electric engines and dynamos, and powerful searchlight. She is to carry a 30-ft. speed motor launch, two 25-ft. gigs, and one 16-ft. dinghy. Cost, with complete outfit and armament, $150,000. Accommodations for the officers and crew are located below the main deck. The total complement, including officers and men, is about forty. Forced draft in the furnaces is obtained with Sirocco fans, a description of which appears elsewhere in this issue.

The Vigilant will displace the Petrel on Lakes Erie and Huron, while the Petrel will be sent to the Maritime Provinces to take the place of the cutter Kingfisher, which has been taken out of commission.

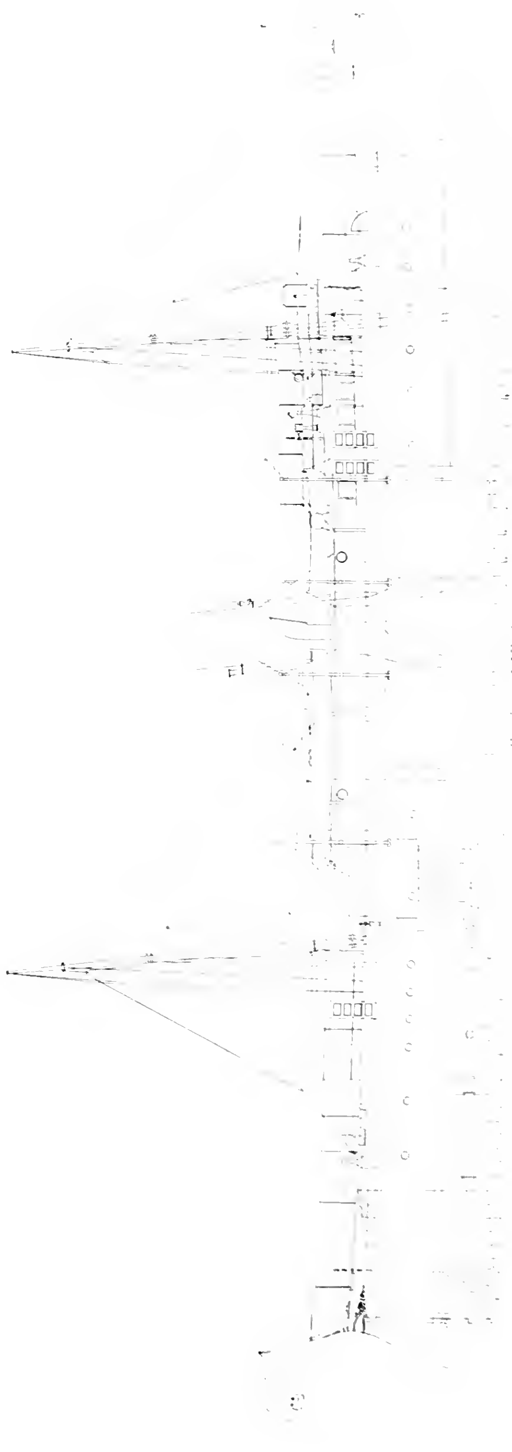
—The Toronto Automobile Club has arranged for a Royal Canadian Automobile and Sportsmen's Exhibition, to be held in Toronto from February 28th to March 4th next. The dates are so arranged that the show will be in the itinerary of the United States Licensed Manufacturers' Association, coming between Cleveland and Buffalo automobile shows. Application has been made for the use of the Armories for the occasion.

—The new lighting plant of the corporation of Picton, N.S., was started October 25th. The plant consists of fire-proof building, two 150 h.p. boilers, horizontal tandem, compound condensing engine, direct connected to 60 cycle, three-phase, 2,200 volt Canadian General Electric Company revolving field generator and direct connected exciter for street and commercial lighting, the Canadian General Electric Company constant current system being employed for street lighting. The plant was designed and built by R. S. Kelsch, consulting engineer, Montreal.



Plan and Deck Plan of Vigilant.

1—Spare room. 2—Magazine. 3—After cabin. 4—Spare state-room. 5—Pantry. 6—Bath. 7—Captain. 8—First lieutenant. 9—Machinery space. 10—Coal bunker. 11—Coal bunker. 12—Second engineer. 13—Chief engineer. 14—First and second mate. 15—Bath-room. 16—Gunners. 17—Officers' mess. 18—Steward and cook. 19—Crew's quarters. 20—Bath-room. 21—Provisions. 22—Chain. 23—Reception rooms. 24—State-room. 25—Bath. 26—Galley. 27—Store-room. 28—Coal bunker.



Section of Vigilant.

ELECTRIC LOCOMOTIVE TESTS.

The New York Central Railmay is electrically equipping its New York terminal for a distance of about thirty miles from the Grand Central Station. The first one of thirty or more electric locomotives to be built for this work was recently completed by the General Electric Co., and the American Locomotive Co., at Schenectady, and on November 12th it was given a public test. From the Electrical World and Engineer we summarize the following description of the new engine:

The locomotive consists of four driving axles on each of which is mounted without intermediate gearing, the armature of a motor having a normal rating of 550-h.p. The motor has two poles with flat faces so as to permit a large relative vertical movement between armature and poles as the latter move up and down with the riding of the frame upon the springs.

The main frame is of cast steel and forms also part of the magnetic circuit of the motors. The armatures are arranged in tandem, the end pole pieces being cast as part of the end frames and the double pole pieces between the armatures being carried by heavy steel transoms bolted to the side frame and forming part of the magnetic circuit as well as cross braces for the truck. The field coils are wound upon metal spools, which are bolted upon the pole pieces. Proper distribution and division of the weight of the locomotive among the axles has been accomplished by suspending the main frame and superstructure from a system of half elliptic springs and equalized levers of forged steel, the whole being so arranged as to cross-equalize the load and to furnish three points of support. This construction, while strong and simple, facilitates repairs and renewals, as an armature with its wheels and axle may be removed as a complete element without disturbing the fields or any other part of the locomotive.

The pony trucks are of the radial type and are pivoted by means of radius bars to the end frame of the main truck. The frame of the locomotive immediately above the trucks is supported by means of suitable links, so that the truck is free to swing about its centre and is self-centering on a straight track. This design is similar to the standard construction adopted by the New York Central Company for its steam locomotives.

The dead weight on the axle is not materially greater than is customary with steam locomotives, and there is no unbalanced weight to produce vibration, so that the reduction in roadbed maintenance expenses, due to the absence of pounding, will be considerable.

The superstructure consists of a central cab for the operator, containing master controllers, engineers' valves and switches, and valves operating sanding, whistling and bell ringing devices. There is a central corridor extending through the cab so as to permit access from the locomotive to the cars behind, and the contactors, rheostats and reversers are arranged along the sides of these corridors. All of these appliances are, therefore, easily accessible for repairs or inspection.

The control system permits three running connections, namely, four motors in series, two groups of two in parallel series, and all four motors in parallel. The motor reverser, contactors, rheostats and other controlling appliances are all of the well-known Sprague-General Electric multiple-unit type. The locomotive is equipped with Westinghouse air brakes, the compressor being operated by an independent motor.

Current is collected from the third rail by multiple-contact, spring-actuated third rail shoes. In the yards at the terminals the large number of switches and crossings necessitates an overhead construction in places, and additional contacts are, therefore, mounted on the top of the locomotive for collecting current when the locomotive is passing over these points. These devices may be raised and lowered by air pressure controlled from the engineer's cab. A magnetic ribbon fuse is placed in circuit with each shoe and overhead contact, so as to secure protection in case of accidental short-circuit.

The general dimensions and data applying to the locomotive are as follows: No. of driving wheels, 8; No. of pony trucks, 2; total weight of locomotive, 95 tons; weight on drivers, 69 tons; rigid wheel base, 13 ft.; total wheel base, 27 ft.; length over buffer platforms, 37 ft.; extreme width, 10 ft.; height to top of cab, 14 ft. 4 in.; diameter of drivers, 44 in.; diameter of pony truck wheels, 36 in.; diameter of driving axles, 8.5 in.; normal rated horse-power of locomotive, 2,200; maximum horse-power, 3,000; normal draw bar pull, 20,400 lbs.; maximum starting draw bar pull, 32,000 lbs.; speed with 500-ton train, 60 m.p.h.; voltage of current supply, 600; normal full load current, 50 amperes; maximum full load current, 4,300 amperes; No. of motors, 4; type of motor, G.E.-84-A.; rating of each motor, 550-h.p.

The maximum speeds reached were 63 miles per hour with an eight-car train and 72 miles per hour with a four-car train. The trains were still accelerating at these speeds, but the length of track so far equipped did not permit attaining higher speeds. In the starting tests a speed of 30 miles per hour was reached in sixty seconds, with an eight-car train weighing, including the locomotive, 431 tons, or an acceleration of one-half mile per hour per second. During certain periods of the acceleration, the increase in speed amounted to .6 miles per hour per second, calling for a tractive effort of approximately 27,000 pounds developed at the rim of the locomotive drivers. This value was somewhat exceeded with the four-car train, where a momentary input of 4,200 amp. developed a tractive effort of 31,000 pounds at the drivers with a co-efficient of traction of 22.5 per cent. of weight on drivers. The average rate of acceleration with the four-car train, weighing, including the locomotive, 265 tons, was thirty miles in 37½ seconds, or .8 mile per hour per second calling for an average tractive effort of 22,000 pounds.

The maximum input recorded, 4,200 amp. at 460 volts, or 1,935 K.W., gives an output of the motors of 2,200-h.p. available at the wheel. With 4,200 amp. and a maintained potential of 600 volts there would have been an input to the locomotive of 2,520 K.W., corresponding to 2,870-h.p. output of the motors. This output is secured without in any way exceeding the safe commutation limit of the motors and with a co-efficient of traction of only 22.5 per cent. of the weight upon the drivers, thus placing this electric locomotive in advance of any steam locomotive yet built. A maximum efficiency of approximately 93 per cent. was shown, this value being fully 4 per cent. better than possible with motors of the geared type. This gain is especially noticeable at the high speeds, the efficiency curve remaining about 90 per cent. even at the free running speed of the locomotive alone, in contrast to the 85 per cent. or less which would be a good showing for a locomotive provided with geared motors. The simple construction and high efficiency made possible with this design of gearless motor, together with the minimum cost of repairs attending such a construction, makes the direct-current gearless motor type of locomotive a distinct forward step in electric locomotive construction.

Compared with existing steam practice, it is interesting to note that the heaviest "Atlantic" type locomotive of the New York Central Company weighs approximately 150 tons, including the tender, on which but 47 tons are on two pairs of drivers. It will, therefore, be seen that for every pound of effective drawbar pull the steam locomotive has a weight of over 12 lbs., as compared with but six lbs. with the electric locomotive. Therefore, in a single electric unit, over 25 per cent. greater weight is available for traction than with the largest steam passenger locomotive now in use, with 37 per cent. less dead weight and with 28 per cent. less weight on each axle. Moreover, the electric locomotive will, of course, have an entire absence of counterbalancing of driving wheels and twist from reciprocal motion, both of which in the steam locomotives are so destructive to track and roadbed.

DEFLECTION OF VOLT METER.

A. W. McIsaac, Sydney, N.S., asks: "Kindly inform me the reason why a volt meter in series, with five lamps on 500-volt circuit, deflects to 500 volts. When it is in multiple with any of the lamps on the circuit it reads the difference of potential between the lamps."

When five lamps of equal resistance are connected in series across 500 volts, there will be a drop across each lamp of 100 volts, and when a volt meter is connected across one of these lamps it will read just a fraction below 100 volts. The reason that it does not read exactly 100 is as follows: Assume that the lamp resistance is for each 200 ohms. Then five in series will give 1,000 ohms across a

500-volt circuit, which will result in a current of a half ampere. If a 500-volt portable Weston volt meter has been used for these readings, its resistance will be found to be about 70,000 ohms. Now, when this meter is connected across one lamp, the resistance between the lamp's terminals is lowered, for there are two circuits in parallel, one through the lamp and one through the meter, the former having a resistance of 200 ohms, and the latter 70,000 ohms. The combined resistance being 199.43 ohms, the total resistance between the 500-volt line will be reduced from 1,000 ohms to 999.43, and the current increased from a half ampere to .5002 ampere. Therefore, the CR. drop across the meter terminals will be approximately 99.75 volts, which, under the circumstances given, will be the meter reading.

Taking up the other proposition, we find as follows: The volt meter resistance being 70,000 ohms when placed across a 500-volt circuit, it will read 500 volts, and the current through the meter will be .0071 ampere. When the five lamps mentioned are connected in series with the meter, the resistance in the meter circuit, between the line wires, is increased by 1,000 ohms, giving a total resistance of 71,000 ohms. The current in this case will be reduced from .0071 ampere to .00704 ampere, and the needle deflection reduced in direct proportion, being approximately 495.7 volts.

CATALOGUES RECEIVED.

The following catalogues have been received by the Canadian Engineer, and may be obtained by mentioning this journal:

Sawyer Tool Mfg. Co., Fitchburg, Mass.; Price list of calipers having friction joint, also other specialties.

Sheldon & Sheldon, Galt; Booklet, "Steel Pressure Blowers," being section catalogue 18.

Power Specialty Co., Windsor and Detroit; Folder describing the Diamond Steam Flue Blower, a new method of handling the soot problem in boilers.

Graham, Morton & Co., Limited, Leeds, Eng.; Catalogue No. 940, of conveying apparatus; 150 pages, fully illustrated.

J. P. Morris Co., Philadelphia; Turbines and Centrifugal Pumps, a 50-page bulletin describing and illustrating water-power and pumping installations at Niagara Falls, Shawinigan Falls, etc., equipped by this company.

Canadian Westinghouse Co., Limited, Hamilton; Circular 1085, Small Induction Motors, Type CC, also folders describing type C motors for A.C. service, and type S motors for D.C. circuits.

The Joseph Dixon Crucible Co., Jersey City, N.Y. A new illustrated catalogue describing the company's well-known graphite and other lubricants, including Dixon's Ticonderoga Flake Graphite, Special Graphite No. 635, Heavy Graphite Machine Grease, Waterproof Graphite Grease, Graphite Cup Greases, Axle Grease, Automobile and Cycle Lubricants, Handy Graphite Rope Dressing, and Graphite Pipe Joint Compound.

W. H. C. Mussen & Co., Craig Street, Montreal.—Leaflets describing concrete working apparatus and contractors' plant; also pamphlet entitled "Concrete Catechism."

The Lunkenheimer Co., Cincinnati, Ohio.—Booklet describing the H.-W. cross-head pin oiler, patented by the company.

The Metallic Roofing Co., Toronto, Ont.—New Catalogue "A," 9 x 13 in., cloth binding, 440 pages, describing the architectural and sheet metal work made by the company, is of Canadian material and workmanship. The edition, which weighs about twenty-five tons, cost upwards of $10,000. The cost of distributing these catalogues will be between $3,000 and $4,000 for postage alone.

Meldrum Bros., Limited, of Manchester, London and Paris (address Atlantic Works, Manchester, Eng.).—Catalogues describing the "Koker" automatic stoker and pate[illegible] forced draught for engines; also catalogue of the new [illegible] drum refuse destructor. Some Canadian testimonial [illegible] showing that the company is cultivating tr[illegible] country.

The Canadian General Electric Co., Toronto.—New catalogue (8 x 10½), containing many illustrations of a large variety of annunciators, bells and house electrical supplies, embracing the latest designs and many novelties. From the same a folder, entitled "Track-cleaner Talks," describing various track-cleaning devices and brooms for which the company are agents; also, instructive booklet on incandescent lamps.

The Allis-Chalmers Co., Milwaukee, Wis.—A book, entitled "The Power of the New York Subway," describing the important part played by the Allis-Chalmers Company in the power equipment of the great enterprise popularly known as the New York Subway.

Fraser & Chalmers, of England, represented in Canada by W. Stanley Lecky, Box 622, Montreal, catalogues on steam boilers, air compressors, stamp mills and accessories, crushing machinery, winding engines and other appliances.

Diamond Saw and Stamping Works, Buffalo, N.Y., folder on "Sterling" hack saws.

Garvin Machine Co., New York, booklet on solid extended milling machine knee.

LITERARY NOTICES.

Automatic Surveying Instruments. By Thos. Ferguson, member of Shanghai Society of Engineers and Architects. 90 pages. Price, 4s. London: John Bale, Sons & Danielsson, Limited.

This book is a complete description of three instruments invented by the author, designed to make automatic records of itineraries, whether over land or water. The pedograph is an instrument which can be slung over the shoulder like a kodak, and which traces out, to scale, a plan of the route traversed, the only attention required being to adjust the instrument occasionally as to level and direction. The cyclograph performs the same function when attached to a bicycle, and the hodograph will record the route travelled by a boat. An introduction to the book is written by E. Hammer, Ph.D., Professor of Geodesy at the Royal Technical High School of Stuttgart.

Smoke Prevention and Fuel Economy. By Wm. H. Booth, M. Am. Soc. C.E., and John B. C. Kershaw, F.I.C. 190 pages; 75 illustrations. Price, $2.50. New York: The Norman W. Henley Publishing Co., 132 Nassau Street.

As the title indicates, this book deals with the problem of complete combustion, which it treats from the chemical and mechanical standpoints, besides pointing out the economical and humanitarian aspects of the question. "We believe," say the authors, "that coal of bituminous quality is capable of perfect combustion, and that black smoke is merely so much evidence of improper design." Chapters of the book deal with the Chemistry of the Combustion Process; Present Methods of Burning Fuels and their Defect; Improved Methods, and Examination of Waste Gases. An appendix describes various English, German, and United States patents for stokers, etc. A complete index adds to the value of the book.

Mechanical Appliances, Mechanical Movements and Novelties of Construction. By Gardner D. Hiscox. 400 pages; 970 illustrations; cloth, $3. Norman W. Henley Pub. Co., 132 Nassau Street, New York.

Though this is a complete work in itself, it is a continuation of the author's previous book on "Mechanical Movements," which went through ten editions. The present work gives illustrations and brief descriptions of 013 examples of machines and devices designed to overcome [illegible]ecial difficulties or do special work, and the value of these [illegible]strations is that they may often suggest a way of helping out of other difficulties that come up in the effort to [illegible] problems connected with new machines. There is a [illegible]ement of fifty-seven patents or devices by which various [illegible]ors have attempted to get perpetual motion. They [illegible] budget of curious information, but the author does

not encourage the hopeless pursuit of perpetual motion. He simply shows the exceedingly ingenious means devised by misguided inventors in their endeavors to solve an unsolvable problem. The pages in which perpetual motion machines are described may induce those who still believe in this *ignis fatuus* to bend their energies in causes more worthy of their zeal. Moreover, some of the mechanical movements evolved by the perpetual motion inventor although they did not attain the end sought by him, may still be applied with profit to his instruction in true mechanical principles and to avoid the errors committed in the attempt to get something out of nothing.

The fifth annual convention of the American Railway Engineering and Maintenance of Way Association was held in Chicago in March last, and the complete proceedings, comprising over 800 pages, besides inserted diagrams and tables, is now published. Reports are given from special committees on buildings, ties, fences, ballasting, masonry, terminals, and several other subjects coming within the scope of the association. A notable feature of many of the committee reports is the definition of terms, which is carried out in a thorough manner. For instance, the correct use of the terms "station" and "depot" is stated, the latter being a storehouse or depository for goods, while the former is the building to which both names have been indiscriminately applied. In all departments the report contains an abundance of information, and it should prove a useful work of reference. The association now has 453 members, representing 184,550 miles of railway in the United States, Canada, Mexico, Japan and elsewhere.

"Mining in British Columbia" is the title of Bulletin 19, issued by the Bureau of Provincial Information of that Province. It is a book of 170 pages, going very fully into the present state of the mining industry in the Province, with brief historical sketches. The compilers freely admit that the tale is not one of unbroken success, for many failures are recorded. The chief drawback experienced in the past, as well as at present, has been the lack of capital. One fact, however, inspires and justifies a great confidence in the future of the Mineral Province, and that is that in the past ten years the annual output has increased more than fourfold. Fifteen thousand copies of the bulletin were printed ten thousand of which were sent to St. Louis for distribution.

The Engineering Directory of October, 1904, is a book of 80 pages, containing classified and alphabetical lists of advertisers in "Engineering." The book is put in neat form for ready reference, and is sent gratis on application to the offices of "Engineering," 35 Bedford Street, Strand, London, W.C.

The Abner Doble Company, of San Francisco, with the permission of the Civil Engineering Department of the Massachusetts Institute of Technology, has published a thesis by H. C. Crowell and G. C. D. Lenth, entitled, "An Investigation of the Doble Needle Regulating Nozzle." It makes a pamphlet of thirty pages, containing about twenty figures and five plates.

The British Fire Prevention Committee have devoted the first number of their quarterly journal to the Baltimore conflagration of February last. The magazine contains a map of the fire area, a series of about seventy photographs of buildings affected, the official Government report of the fire by Capt. Sewell, the report of the Boston Mutual Experiment Station, and the conclusions of the special committee of the National Fire Protection Association of the United States. The whole is arranged by Edwin O. Sachs, F.R.S.Ed., who also contributes a summary of the technical features of the fire and of the lessons to be drawn. Among other preventive measures which the Baltimore fire has shown to be necessary Mr. Sachs finds these: The restri[illegible]tion of cubic contents of individual risks; the guarding [illegible] external openings with shutters or otherwise; the pro[illegible] [illegible] of all iron-work by concrete or terra-cotta; the [illegible]tion of the use of stone for supports; the provisi[illegible] means of rapidly cutting off gas, water and electrical su[illegible] of blocks of buildings, and special water supply for fi[illegible]poses. The book should be of great value in the cause of fire prevention. It is published by the committee at 1 Waterloo Place, London, S.W. Price, 5s.

The publishers of the Canadian Magazine are to be congratulated on the production of a very attractive Christmas number, which will make a suitable gift to send to friends abroad. It is pleasing to learn from the publishers that this magazine is displacing to a greater extent than heretofore the foreign publications so largely used here for Christmas souvenirs. In this number Mr. Waters, a returned self-supporting missionary, gives a picture of social life and customs in Tongaland. Sir Gilbert Parker tells of his experiences during his first days in the House of Commons. William Wilfrid Campbell contributes a two-page poem, and there are half a dozen short stories.

It is reported that the Delaware, Lackawanna and Western Railway will convert their motive power from steam to electricity, beginning the installation very soon.

—Willis Chipman, C.E., Toronto, has been instructed by the council of Portage la Prairie, Man., to prepare plans for a new water-works system for the town. Test wells are now being sunk for water supply, but the piping will not be laid till spring.

—The Ontario Government will appropriate $180,000 to the building and equipment of a department of physics, which will mean a large extension to the equipment of the present School of Practical Science. The Government will also give $10,000 to aid the University of Ottawa in equipping an engineering department.

At the Liberal convention in Toronto last month, one of the resolutions passed endorsed the principle of municipal ownership of public utilities, such as water, gas, electric light, telephones, street railways, etc., and expressed the opinion that hereafter no franchise should be given to a private corporation for a period exceeding 30 years.

The Hamilton, Ancaster and Brantford Railway, which had right of way through all but one of the municipalities, and which had let contracts for construction, has been blocked by Barton Township Council, who make almost impossible conditions for the right of way over a quarter-mile of road, which they control. Hon. Charles D. Haines, of New York, the chief promoter of the road, says he will abandon the scheme.

—At the first meeting of the Electrical Section of the Canadian Society of Civil Engineers, held 3rd November, a paper on "The Design, Construction and Testing of Core Type Transformers," was read by A. E. Foreman, student member of the society. A meeting of the Mechanical Section was held on Thursday, 24th November, when a paper on "The Measurement of Water by a Venturi Meter, Viewed from a New Standpoint" by R. Steckel, member of the society, was read.

—Eugène P. Poisson, civil engineer, representing the Fèves Lille Company, of Paris, France, and Eug. Parrot, engineer of the Société de Construction des Batignolles, of Paris, favored the Canadian Engineer with a call a few days ago. Messrs. Poisson and Parrot are visiting Canada in the interests of a number of companies and syndicates in France, who have in contemplation the investment of capital in Canada or the establishment of agencies for promoting French trade with Canada. They have travelled from the Pacific Coast east, and are [illegible]t the Windsor Hotel, Montreal during December. They ex[illegible]s themselves as much interested in the developments now [illegible]on in Canada, and no doubt the result of their visit will [illegible]ening up of some new trade or industrial connec[illegible] [illegible]n France and Canada.

—The Toronto branch of the Canadian Manufacturers' Association has now 425 names on its membership roll, and the council of the branch has decided to inaugurate five sections, which will include the various classes of manufactures, and which will each have their own governing body. The sections will be described as the dry goods, leather and paper, wood manufactures, metals and jewellery, and groceries, drugs and chemicals, departments. An Executive Committee will be elected by each.

❦ ❦ ❦

—Sir Guilford Molesworth, the new president of the Institution of Civil Engineers, spent more than thirty years in India and Ceylon, and made those realms the subject of his inaugural address. Public works policy there has swung between private and state enterprise, the author showing a decided preference for state ownership. In Ceylon, with which Sir Guilford was long associated, the profits of the railways have already more than covered the capital outlay. The future of India must depend mainly on works carried out by civil engineers.

❦ ❦ ❦

John Bertram, president of the Bertram Engine Works, Limited, Toronto, president of the Collins Inlet Lumber Co., and chairman of the Dominion Government's recently created Commission on Transportation, died a few days ago in Toronto from appendicitis. Mr. Bertram was also a member of the Ontario Forestry Commission, and was a high authority on lumbering and forestry questions. In 1900 he succeeded his brother, the late George H. Bertram, as president of the engine company bearing his name. Mr. Bertram was a man of plain life and strong common sense, and took a keen interest in public questions. He is survived by seven children, of whom Robert Bertram is vice-president of the engine company.

❦ ❦ ❦

The Allan Liner Parisian, which for years has been the queen of the Allan fleet, is being retired from the Liverpool-Montreal route. Next season the Victorian, the Virginian (turbine steamers), the Tunisian and the Bavarian will constitute the fleet on this route. The Parisian will probably run from New York to Glasgow, though this is not determined. She was built in Glasgow in 1881, by Charles Napier & Sons, and was one of the first of the trans-Atlantic liners to be constructed of steel. In her twenty-three years of service she has never met with an accident of any consequence and never has lost a life. Originally the engines were of the old-fashioned type, but a few years ago she was over-hauled, and triple expansion engines were installed.

❦ ❦ ❦

—Sir Wm. Garstin, G.C.M.G., has just issued a report on various schemes for controlling the Upper Nile. Sir William has been studying the river for five years, and he has proved that the White Nile contributes almost nothing to the volume of water flowing to the delta, almost eighty per cent. being lost in its passage through swamps between Lado and Fashoda. Sir William's proposal is to cut a new channel 200 miles long, to the eastward of the present channel. Alternately, he would train the present channel by damming the tributaries and planting trees at intervals for hundreds of miles. Several subsidiary works would be necessary, in the way of regulating the flow from the feed lakes, etc. The total expenditure would amount to over £20,000,000, and the work would take ten or fifteen years to complete. The result would be to add fifty per cent. to the volume of the White Nile at Khartoum.

❦ ❦ ❦

—The Canadian Westinghouse Company has sold to the Hamilton Cataract, Power, Light and Traction Company, for use in its Victoria sub-station, at Hamilton, two motor generator sets, each consisting of a synchronous motor and a direct current generator. The motor-generator sets will be of the two-bearing type, the generators delivering direct current at 550 volts to the railway system, and each being rated at 750 K.W. The synchronous motors will take two-phase current at 8,000 alternations and 2,400 volts and will be rated at 1,380-h.p. The excess of capacity in the motors is provided so that they may be used for raising the power factor [illegible] system. Power is taken through lowering transformers [illegible] high tension transmission line from the [illegible] of the company. These motor-generator [illegible] at the works of the Westinghouse Electric and Manufacturing Company, at East Pittsburgh, Pa.

❦ ❦ ❦

—The Portland Cement Company, Limited [illegible] has been incorporated with a capital stock of [illegible] lars. Operations are to be carried on at the [illegible] Springfield and the head office will be at Winnipeg. [illegible] pany is composed of D. A. Keizer, C.E. [illegible] financial agent; R. R. Sutherland [illegible] gentleman; C. J. Jamieson, M.D., of Winnipeg [illegible] W. Shunk, of Ste. Anne.

❦ ❦ ❦

—The Arcola branch of the C.P.R. was opened for traffic last month. This section is 113 miles long, running from Schmeitzer Junction to Arcola, and opens up rich new [illegible]. It also gives a second connection between Winnipeg and Regina. The connection made a month ago at Emerson gives the C.P.R. four lines connecting Winnipeg with St. Paul and Minneapolis. Among the other works carried out by the company during the past season is a change of location of sixty miles, between Swift Current and Moose Jaw, made to get an easier grade, while a reduction of grade has been obtained at Broadview and between Winnipeg and Fort William. A new branch has been built east from Lacombe on the Calgary and Edmonton line, one from Wetaskiwin east to intersect the Long Lake and Saskatchewan. The Kirkella branch is also being extended. Double tracking between Winnipeg and Fort William will probably be carried on through the winter.

❦ ❦ ❦

Frank H. Mason, United States Consul at Berlin, reports on a German patent for a process of electric heating, which can be applied to house warming as well as the smelting of metals. A compound called "Kryptol," composed of a mixture of graphite carborundum and clay, is placed on an earthenware plate having carbon electrodes on its opposite sides. The mixture is in granules offering resistance to the electric current according to the fineness of the grains, but the grains are not destroyed by the heat. When the "Kryptol" covers the plate entirely the circuit is complete, and heat generated in the mass. The heat can be controlled at will, as it is generated only where the layer is thinnest and is limited to the thin spot. Having the grains fine or coarse also varies the heat. It is said that while the thin spot may be made incandescent, the parts where the layer is thick will be so cool as to be easily stirred by the naked hand. It is said to be applicable to heating rooms, street cars, etc., though how the mixture would keep a determined level in a jarring, oscillating car is not apparent by the description.

❦ ❦ ❦

—The report of the directors of the British Columbia Electric Railway for the past year states that the business of the company has continued to grow in all departments. A number of further contracts for sale of power have been made during the year. This branch of the business will be much extended when the Vancouver power installation is complete. Less than one-third of the tunnel between Trout and Coquitlam Lakes remains to be driven; the concrete dam at Trout Lake, the power-house, and the sub-stations have all been completed, and three pipe-lines are in place. Since December 10th, 1903, the City of Vancouver street lighting has been carried out by means of power delivered from Trout Lake, and a contract has been entered into to supply the City of New Westminster with power for street lighting over a term of years. The engineers estimate that the work will be completed about May, 1905. The negotiations for the purchase of the Vancouver Gas Company have been successfully carried through. The cessation of competition between these undertakings has resulted in benefit both to the British Columbia Electric Railway Company and to the public in Vancouver. The price of electricity has been lowered since the purchase.

Indian Head, N.W.T., is considering the installation of a street lighting plant, and a waterworks system under municipal ownership.

—W. Kirkwood, formerly of Toronto and Belleville, has opened an iron rolling mill in Winnipeg, for the manufacture of all kinds of steel and iron supplies for railway and other enterprises.

—The annual meeting of the American Society of Mechanical Engineers will be held in New York from the 6th to 9th inst. in the society's rooms at 12 West 31st St.

—The Grand Trunk Railway Co. has been awarded two gold medals at the World's Fair for its exhibits in the fish and game building. The company received similar honors at Paris, in 1900, and at Osaka, Japan, in 1903.

—While hunting for relics of the stone age, in Northern Manitoba recently, Prof. P.G. T. Kendall, of Tulane University, New Orleans, found a rich ledge of copper with extensive surface croppings. He proposes to test it more thoroughly in the spring.

—A valuable deposit of cement marl has recently been discovered near Winnipeg. It varies from 7 to 25 feet in depth and the area is said to be 750 acres, or sufficient to produce a million and a half barrels of cement. T. O'Doherty, Main St., Winnipeg, reports that Prof. Kendrick has made an analysis of the marl and pronounces it to be like English marl in character.

—The Dominion Government has been asked to assist a company to be known as the Canadian Tin Plate and Pressed Steel Co., who will establish a factory at Morrisburg, if permission is granted for the use of the Williamsburg Canal for water-power. They will employ 150 hands at first, which number is to be increased ultimately to 1,000. Over one hundred skilled workmen will be brought from Wales.

—A new law, providing compulsory compensation for factory employees and miners in the case of all accidents, has been put into force in Russia. In the event of death an annuity is payable not only to widows and legitimate children, but to illegitimate children and to the mothers of such children, and also to adopted children, the annuity to equal the wages of 260 days per annum, whereas the average of working days in Russia only number 220.

—The 18th annual banquet of Toronto, No. 1, Canadian Association of Stationary Engineers, was held at the Walker House, Toronto, on November 16th, President W. L. Outhwaite in the chair. After an excellent menu, toasts were proposed in honor of the King; Canada our Home; Toronto our City; the Legislature of Ontario, by Thomas Crawford, M.P.P.; Manufacturers, by John J. Main and E. E. Keele; Education; Executive Council; Sister Societies; the Mechanical Press; Our Guests. A programme of songs and recitations was rendered between the toasts. About 175 members and friends enjoyed the evening.

—The Free Press, Winnipeg, reports that the Manitoba Gypsum Company has succeeded the old Manitoba Union Mining Company, which has been in operation for the past three years at Gypsumville, Lake Manitoba. Lying adjacent to the property of the Manitoba Union Mining Company is a gypsum deposit 1,200 acres in extent which belongs to Wm. Martin of the Northern Elevator Company, and Hon. Hugh Sutherland. The combination of the two properties gives the new company gypsum lands of over 2,000 acres in extent, and the control of the only large gypsum deposit yet discovered in the Canadian West. The new company, in addition to the lands, have acquired the fine gypsum mill, erected two years ago at Gypsumville, and which has a capacity of 10,000 tons per annum. This mill will immediately be enlarged to a 20,000-ton mill. Gypsumville is about twelve miles from the quarries at present opened and already the new company have a gang of men out cutting ties for a narrow gauge tramway to connect the quarries and mills. In addition to the steamer Petrel, purchased from the Union Company, another steamer is being acquired. These steamers will bring the finished products down to Westbourne or Delta for transhipment by rail east and west. The officers of the new company are: B. C. Mason, Kansas City, president; William Martin, Winnipeg, vice-president and general manager; Hon. Hugh Sutherland, Winnipeg, secretary-treasurer; James Fisher, W. J. Holahar, Mason City, Iowa; T. A. Potter, of the same place; D. E. Roberts, of the Plymouth Plaster Company, Fort Dodge, Iowa, directors. The Plymouth Plaster Company, with which Mr. Roberts is connected, is one of the largest concerns of its kind in the United States. The company will find occupation for 100 to 125 men.

—The exciter plant of the Canadian Niagara Power Co., at Niagara Falls, Ont., is now in operation, and the first and second units of 10,000-h.p. each are to be ready to generate electric power by the 1st of January. Until calls are made for power on the Canadian side the current from these two generators will be transmitted to Buffalo to supplement the power sent from the United States side of the Falls.

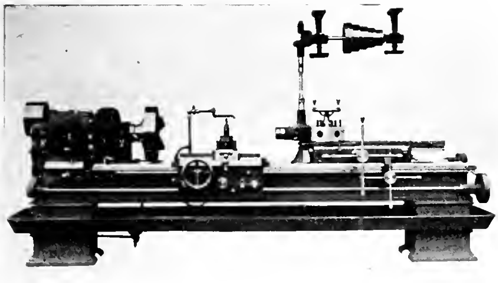
—During the past two years the Vulcan Iron Works, of Winnipeg, have been greatly extended. The company moved into one new shop last spring, and another new one has recently been finished and occupied. One of these shops is 264 by 100 feet, the other 200 by 100 feet, the original shops being only 100 by 70 feet. The company will build its own power house and have its machines operated by electricity. The new shops include boiler shops, foundry, and general machine shops, and are being fitted up with the most modern tools. John McKechnie is president of the company.

—A conference was recently held at Glace Bay, N.S., between the officers of the Dominion Coal Co. and delegates from the P.W.A. A fear had prevailed that a cut would be made in wages during the winter, which would be certain to be followed by a strike in the spring. The arrangements arrived at, however, are such as will give the coal trade in Cape Breton a degree of stability such that the company can reach out after contracts unhampered by fear of labor troubles to handicap them in the falling of the same. The present rate of wages is to prevail for three years. The over-crowding of mines is a matter of great moment to the men. This phase of the subject will also receive consideration.

—In 1898 the Newfoundland Government made a contract with the Reid Newfoundland Railway Co. by which the company was given the right to operate, for fifty years, the railways and the telegraph lines connected with them, as well as certain other telegraph lines in the island that belonged to the Government. At that time the Anglo-American Cable Company enjoyed a qualified monopoly of telegraphic service in the island, which, however, was to terminate in April last. In view of the Anglo-American monopoly the Government gave to the Reid Company a subsidy of $10,000 a year to operate the telegraphs until the date of the expiry of the Anglo-American monopoly, as mell as all profits during that period and until the end of the fifty-year period in 1948. The Government, however, have been anxious to take back the telegraphic service. To determine the compensation, if any, to be paid the Reid Company for the surrender of rights, arbitrators have been appointed, Hon. Edward Blake, named by the Government, Donald McMaster, K.C., by the company, and P. S. Archibald (formerly chief engineer for the Intercolonial Railway), by the courts of Newfoundland. This arbitration board sat at St. John's from October 27th to November 19th, and all evidence was put in. The board will meet again in Toronto on January 9th next.

ROUGHING AND BORING LATHE.

The accompanying illustration presents a very interesting machine just brought through by The American Tool Works Co., of Cincinnati—a 22-inch "American" lathe with patent all geared head, pan, oil pump, turret, and special boring device. The entire screw cutting mechanism has been omitted on this machine, inasmuch as the lathe is primarily intended for roughing and boring, and the feeding mechanism, while of the same principle as that regularly incorporated on the "American" lathes, is of a special nature. There are seven carriage feeds, ranging from .2 to .015, being scientifically graded for the greatest efficiency in that character of roughing and boring planned for this lathe by the customer. The patent geared head is an extremely simple, powerful, and efficient construction. Only six gears are required to obtain four speeds through levers shown on the front. This simplicity of construction enables the gears to be made of very wide face, and large diameters, this giving the entire mechanism sufficient strength to transmit the maximum power delivered to the machine by six-inch double belt. The four speeds obtainable through the head, in connection with a triple friction countershaft supply twelve distinct speeds to the spindle, ranging from 5 to 322 R.P.M. The carriage is fitted with plain block rest, which is provided with an interesting calipering attachment. This consists of a set of four adjusting screws, attached to the plain block rest after the manner of eyebolts, each one falling, when desired, over into corresponding slots in the yoke piece over the front carriage dovetail. By adjusting knurled locknuts on any of the four screws and dropping same into the slot, the travel of the cutting tool toward the centre, and hence the diameter to be turned is limited at pleasure. This attachment is very valuable in duplicate work, as adjustments can be made for duplicate turning of pieces with four shoulders. The hexagon automatic turret is of liberal size, with rapid and easy adjustments. Is provided with power feed, driven by sprocket chain from the feed rod, thus giving fourteen feeds to the turret, ranging from .16 to .007. The worm is dropped out of mesh with the wheel by an improved tripping device, adjustable at will from the front of the machine. The turret slide has extra long bearing on the bed; the top slide has 24-inch movement, controlled by pilot wheel, and is supported on the front end by an improved supporting shoe, which slides on the ways, and is firmly bolted to the end of the turret slide directly under the cutting tool. It ensures accurate alignment in boring, and has gibbed bearing both at the top and bottom of ways, thus preventing all spring in any direction. The drilling attachment is affixed to one of the faces of the turret, and is extremely valuable in boring operations. It consists of a symmetrical housing carrying mitre gears, which actuate a spindle with ball bearing thrust, which carries the boring bar. The spindle is made to revolve from a separate overhead countershaft, as shown in the illustration, by means of universal joints connected by a telescopic rod, which thus compensates for any movement of the turret slide. The boring spindle revolves in the opposite direction to the main spindle on the head, an obvious advantage. The boring spindle has five rates of speed through the cone pulley on the countershaft giving proper gradation to obtain the best results in the boring for which the lathe is intended. Whenever it is desired to use another face of the turret, it may be revolved without disturbing the drilling attachment, due to the telescopic rod. The boring tool is provided with oil supply, same being drawn by auxiliary pump up through the turret stem and boring bar.



The carriage has similar [illegible] pan beneath the bed [illegible] the machine [illegible] tial throughout, to adapt [illegible] a lathe of this character [illegible] will be furnished by the makers.

ELECTRIC TRACTION FROM GAS POWER.

A new departure from established [illegible] tion has recently been undertaken at Warren, Pa. The Warren & Jamestown Street Railway Company is equipping an alternating current, single-phase electric railway system to operate between Warren, Pa., and Jamestown, N.Y., for which power will be supplied by gas engines operating upon natural gas. The equipment is now being constructed by the Westinghouse Companies at East Pittsburg, Pa. The power station will be located at Stoneham, Pa., two miles from Warren. The initial equipment will consist of two Westinghouse gas engines each of 500 brake horse-power capacity. They will be of the horizontal, single-crank, double-acting type, direct connected to two 260-K.W. Westinghouse generators furnishing current at voltage sufficient for direct use upon high tension transmission line. The power equipment also comprises a 55-h.p. Westinghouse gas engine for operating air compressor and exciter unit. Natural gas will be used, furnished by the local distributing company. In this district the gas has a calorific value of about 1,000 b.t.u. per cub. ft. Transformer sub-stations, five in number, will be located along the right of way. These will receive the high tension current from the transmission line and reduce the voltage to such an extent as to render it more suitable for use in single-phase motors. The present motive power equipment will comprise four quadruple sets of Westinghouse single-phase motors, each 50-h.p. capacity. An interesting feature of the system is the arrangement for operating alternating current motors upon the direct current trolley lines within the city limits of the termini. The Warren & Jamestown Street Railway is not a newly-organized system, as it has operated part of the present lines for a period of eleven years. Three years ago the company began experimenting with the use of gas power, with sufficient success to influence them in the new exclusive adoption of gas engines for their entire power generation. The operation of the new system will be watched with much interest by the engineering public, and its success will mark an important advancement in modern electric railroading.

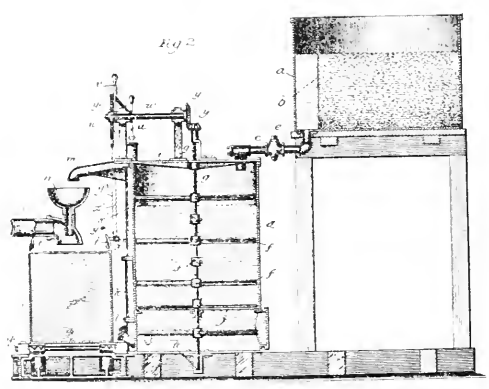
PURIFYING WATER FOR ENGINES.

An instructive report on water purification for engine use has been made by a committee of the Association of Railway Superintendents of Bridges and Buildings (U.S.). The committee embodies in its report a memorandum by G. M. Davidson, chemist and engineer, of the Chicago and Northwestern Railway, who observes that the character of water for boiler use may be influenced by the following: 1. By the kind of rock and soil through which it passes. 2. By the depth to which it penetrates the rock and soil. 3. By the time that it remains in the earth. All natural water contains more or less solid matter in solution, or mixed with it mechanically and held in suspension. The ideal water for use in locomotive boilers is one that does not deposit scale, does not corrode, and does not cause the boilers to foam. Unfortunately, such a water does not exist in nature.

Of boiler compounds, he says: The number of boiler compounds on the market are so numerous that I will only refer to a few of them in a general way. Some are entirely mechanical in their action, such as wires, plates, twigs, and brushes, which are supposed to catch and entangle the scale-forming matter and prevent it depositing and forming hard scale. Others are supposed to have a chemical action, and indeed are well known chemicals that do have such action, but the high prices of such chemicals limit their use. Others, like potatoes, peas, wheat, moss, crude oil, kerosene, etc., are of some little benefit because they form centres about which the lime and magnesia gather and thus prevent the formation of hard scale. It was once customary for owners of boilers to use various boiler compounds.

boiler purgers, boiler scale dissolvers, and similar nostrums, which were offered from time to time and which were represented to cure the evils due to the use of poor water. After experimenting and trying a great many of these boiler compounds, it was concluded that while many of them seemed to give fairly good results, yet a large portion were humbugs. Many of them contained well known chemicals which, when properly used, would give fair results. Some of them contained material that yielded doubtful results. Some of them were found to contain chemicals which were known to be very harmful to boilers. Some ten years ago it was found that if properly used, soda ash in locomotive boilers would yield fairly good results. You will note that I say "if properly used," because it was found that if used improperly, soda ash would do more harm than good to a locomotive boiler. When soda ash was first used, the locomotive engineers were divided into two classes in regard to their opinions as to the benefit derived from its use. Some of them declared it did good work in locomotive boilers, while others declared just the reverse. Upon investigation it was found that the proper use of the blow-off cock had much to do with the results obtained. If the engineer used the blow-off cock frequently and thus removed the "sludge" and concentrated water from his boiler, the results were generally fairly satisfactory. A boiler, however, was not designed for the purpose of treating water with chemicals and the use of a locomotive boiler as a vessel in which to carry on a chemical operation was found to be poor practice. As the use of boiler compounds required their introduction into the boiler, they did not meet with very much favor.

The hardness of boiler water depends upon the quantity of lime and magnesia compounds that it has in solution. There are two kinds of hardness, commonly distinguished as "temporary hardness" and "permanent hardness." "Temporary hardness" is due to carbonate of lime and carbonate of magnesia held in solution by carbonic acid gas. Such water may be softened by boiling and thus driving off the carbonic acid gas, or by adding to the water some chemical that will unite with or absorb the carbonic acid gas. "Permanent hardness" is due to the sulphates of lime and magnesia, and sometimes some other compounds which are dissolved in the water. These remain in



solution after water is boiled because they do not depend on carbonic acid gas to hold them in solution. The principles of the art of water softening have been known for over one hundred years, but it was not until the year 1841 when Dr. Clark, of Scotland, took out his famous patent for softening water on a large scale, that an attempt was made to soften water for boiler use. The Clark process is the basis for all other water softening processes that have been commercially successful.

The chemical treatment of water before it is used in boilers has been carried on in Europe for a number of years, but only recently has the subject been given much thought in this country, even for stationary boilers, and the purification of water for locomotive boilers has only been taken up by the railway companies during the past few months.

All water used for boiler purposes, unless it is rain collected from the roof of a building and not allowed to come in contact with the earth, contains more or less scale-forming material in solution. This scale-forming material is composed of compounds of lime, magnesia, iron, alumina, silica, etc. Of these the carbonate and sulphate of lime and the carbonate and sulphate of magnesia form 98 per cent. of the scale, and it is these four compounds that generally cause trouble in boilers. It is to the removal of these compounds that I will particularly call your attention.

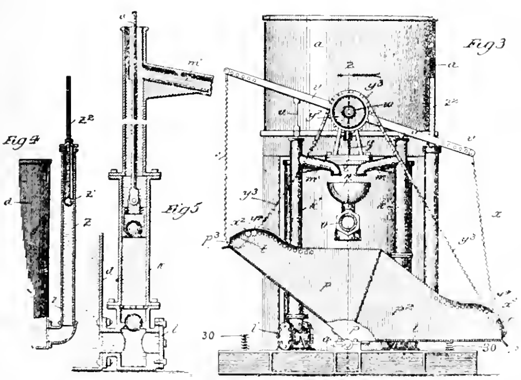
Carbonate of Lime is the chemical name for common limestone, marble, and chalk. It is the commonest form in which lime is found in water. It is but slightly soluble in chemically pure water, but is readily soluble in water which contains carbonic acid gas. Rain water, in falling to the earth, absorbs carbonic acid gas from the atmosphere. When water charged with carbonic acid gas passes through the soil, it dissolves more or less of the lime that is in the soil. In localities where such water comes in contact with limestone the amount of lime dissolved by water passing through it is very large. When such water is boiled the carbonic acid gas is driven off by the heat, and the lime which was held in solution by it is deposited on the inside of the boiler. Carbonate of lime alone does not form very hard scale, but it is rather bulky because when crystallizing carbonate of lime combines with many times its weight of water. The white, chalky matter that is washed out from boilers and which can often be seen about roundhouses, is impure carbonate of lime. Since carbonate of lime is held in solution in water by the presence of carbonic acid gas, any means that will remove the carbonic acid gas from the water will at the same time throw out of solution the carbonate of lime. There are many chemicals which when added to cold water will combine with the carbonic acid gas in the water and thus remove it from the water. The one chemical most available for this purpose because of its great abundance and low cost, is common building lime. This is called quick lime. Chemically considered, it is a compound of lime and oxygen. When common lime is mixed with water it unites with a portion of the water and forms a new product, commonly known as slaked lime, which is chemically called hydrate of lime. When slaked lime is added to the water containing carbonate of lime held in solution by carbonic acid gas, it unites with this carbonic acid gas, forming carbonate of lime, which being insoluble in the water freed from its carbonic acid gas, settles down as a white precipitate. The carbonate of lime, which was held in solution by the carbonic acid gas, is thrown out of solution as soon as the gas is removed by the slaked lime, and also settles in the form of a white precipitate. Therefore, to remove carbonate of lime from a water before it enters a boiler, it is only necessary to add to the water the proper amount of slaked lime required to combine with the carbonic acid gas that holds the carbonate of lime in solution, and allow the resulting precipitate to settle. The clear water above the sediment that settles out, can then be used in a boiler without causing scale to be formed from any carbonate of lime that may have been in the water before it was treated.

Sulphate of lime, which is commonly known as gypsum or plaster of paris, is found in a great many waters, and is responsible for the hard scale which is often found on flues and crown sheets of boilers. Scale formed from sulphate of lime alone is often as hard as porcelain. It is not thrown out of solution until the water is heated considerably above the boiling point, namely, 302 degrees Fah., which corresponds to about 55 pounds' boiler pressure. The sulphate of lime is precipitated in the form of heavy crystals, which unite with such other deposits as are in the boiler, and form a hard cement-like coating on the flues and sheets. It is a very poor conductor of heat, so that when flues are coated with it it is necessary to burn a greater amount of coal in order to produce steam. Sulphate of lime being soluble in water that is free from carbonic acid gas, it cannot be removed from water by means of slaked lime. It can, however, be removed by means of carbonate of soda, commonly known as soda ash. The chemistry of this process is as follows: When a water containing sulphate of lime dissolved in it is mixed with a water solution of carbonate of soda, a chemical reaction takes place. This chemical reaction may be expressed as follows: Sulphate of lime and carbonate of soda when dissolved in water and mixed, react and form carbonate of lime and sulphate of soda. The sulphuric acid, which was combined with the lime as sulphate, leaves the lime and combines with the soda, forming sulphate of soda, while the carbonic acid gas, which was combined with the soda, leaves the soda and combines with the lime, forming carbonate of lime.

Carbonate of lime, being insoluble in water free from carbonic acid gas, settles down as a white precipitate, while sulphate of soda, being soluble, remains in solution. Therefore, to remove sulphate of lime from water before it enters a boiler, it is only necessary to add to the water the proper amount of soda ash required to combine with the sulphate of lime, allow the resulting white precipitate to settle, and then draw off the clear water.

Carbonate of magnesia is the commonest form of magnesia. It acts like carbonate of lime, being held in solution by carbonic acid gas dissolved in the water, and thrown out of solution when this gas is driven out of the water. By simply mixing slaked lime with water containing carbonate of magnesia in solution, the carbonate of magnesia is thrown out of solution in a manner somewhat similar to carbonate of lime, already described, so that the treated water when used in a boiler does not deposit scale from any carbonate of magnesia that was in the untreated water. We are all familiar with the magnesia boiler lagging, which is applied to the outside of the boiler to prevent the radiation of the heat, on account of magnesia being a poor conductor of heat. When the magnesia, however, is deposited on the flues or firebox inside of the boiler, it is surely on the wrong side of the shell.

Sulphate of magnesia, commonly known as epsom salts, does not of itself form boiler scale, but when it is in a boiler with a soft carbonate of lime scale, a chemical reaction takes place which results in the formation of hydrate of magnesia and sulphate of lime. These two compounds form a very dense



scale as hard as stoneware. Sulphate of magnesia can be removed from water before it enters a boiler by treatment with caustic soda, or what amounts to the same thing, and is cheaper, with slaked lime and soda ash.

The above mentioned two compounds of lime and two compounds of magnesia are the cause of almost all of the trouble with boiler waters that deposit scale, and are also the cause of much extra coal being used to generate steam. Rankine, in his book on mechanics, states that the resistance to the passage of heat offered by wrought iron being taken as 1, that of copper is 0.4; of slate, 9.5; of brick, 16; carbonate of lime, 17; and of sulphate of lime, 48.

Sometimes a water that is obtained near mineral veins contains free sulphuric acid, and, of course, such water is very corrosive. The addition of lime to such water neutralizes the acid. Water from mountain streams and from streams near waterfalls is also corrosive. This is due to the absorption by the water of oxygen and carbonic acid from the air. Likewise water that has had air pumped into it is corrosive for the same reason. Some waters from streams contain sand or mud in suspension. These can be removed by filtering, or precipitated by the use of alum or sulphate of alumina. If such water is hard it can be softened at the same time that suspended matter is removed.

Briefly stated, the scale in locomotive boilers is due to one or more of the following causes: 1st. Deposition of lime and magnesia carbonates, due to the boiling off of the carbonic acid gas from the water in which they were dissolved. 2nd. Deposition of sulphate of lime, due to high temperature in the boiler. 3rd. Deposition of magnesia compounds, due to their decomposition in the boiler. 4th. Deposition of [illegible] and other matter that was suspended in the water. 5th. Deposition of alkali salts, due to concentration.

We have seen that in order to remove from hard water the scale-forming compounds of lime and magnesia, it is necessary to mix with the hard water the proper amount of slaked lime and soda ash. The mechanical operations required may be classified as follows: 1st. Weighing, mixing and dissolving the lime and soda ash in water so that the resulting mixture will have a uniform and constant strength. 2nd. Mixing a certain predetermined quantity of this chemical solution with a certain predetermined quantity of the hard water, and agitating the resulting mixture so thoroughly that the lime and magnesia compounds that were dissolved in the hard water are quickly thrown out of solution in the form of a white precipitate. 3rd. Separating and collecting this precipitate from the clear softened water.

These mechanical operations should be conducted at a minimum cost, and therefore, the mechanical apparatus should be simple and as nearly automatic as possible; easily adjusted to suit the different waters; not liable to get out of order; be operated without any extra power other than an ordinary pump, such as is used at water stations; so simple that an ordinary pumper can attend to it without neglecting his regular work, and so cheap that the cost of installation does not prohibit its use.

The author then describes an apparatus constructed for the company's use. Fig. 2 is a section, and Fig. 3 is an end elevation of same. Fig. 4 is an elevation partly in section, showing the float and gauge for measuring the depth of chemical solution in the chemical tank. Fig. 5 is an enlarged vertical section of one of the pumps, showing the arrangement of ball valves and connection of the pump to the chemical tank. Fig. 6 is a sectional elevation of the settling tanks and pump house, showing the location of the entire apparatus for storing, feeding, mixing and settling water.

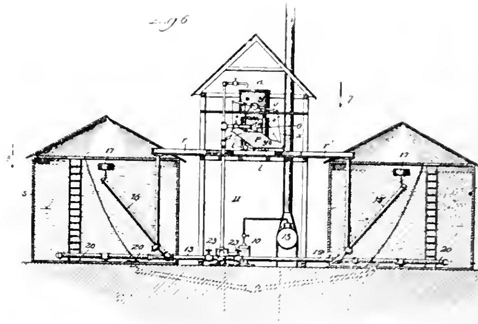
The operation of the apparatus is as follows: The proper quantity of chemicals, usually lime and soda ash, having been determined, they are weighed out and dumped into the mixing vat *a* (see Fig. 2), where they are mixed and dissolved in a proper quantity of water to make the solution the strength desired. By opening the valve *c* this solution is allowed to run into the chemical tank *d*. To thoroughly mix and keep the solution stirred up in the chemical tank *d*, stirring blades are fixed on the vertical shaft *g*, which rotates in the centre of this tank. In order to measure and deliver predetermined quantities of the chemical solution, the chemical tank *d* is provided with two pumps k and k^1 (see Fig. 3) connected at the lower portions to the chemical tank *d*, through the T's l and l^1. The upper portions of these pumps have discharge pipes m and m^1, which discharge into a funnel *n*, attached to an elbow terminating on the hard water supply pipe, so that just before the hard water passes out of this pipe the chemical solution is mixed with it.

To obtain the best results it is essential that the quantity of the standard chemical solution and hard water be mixed in proper proportions, and also that this be done regularly whenever the apparatus is being used, also that it be done economically. To do this a tilting vessel *p* (see Fig. 3) is used. It is supported on a shaft *q*, which is located directly under the elbow from which the mixed hard water and chemical solution is discharged. This tilting and measuring vessel is divided into two compartments of equal capacity, p^1 and p^2. When it is in the position shown in Fig. 3, the mixture of hard water and chemicals falls from the discharge elbow *o* into the compartment p^1. When this compartment is nearly filled it counterbalances the weight of the other compartment p^2, so that the vessel tilts until it strikes the springs 30, emptying the contents of the compartment p^1 and at the same time bringing the other compartment p^2 under the discharge elbow *o*. When this in turn is filled it reverses the movement of the tilting vessel *p*, emptying the contents of the compartment p^2, and bringing the compartment p^1 again under the elbow *o*. For convenience these compartments p^1 and p^2 are made such size that 100 gallons of water are required to fill them to the point where they commence to tilt and empty their contents. Having determined the amount of a standard solution of chemicals required to precipitate the scale-forming compounds from say 100

gallons of any hard water, it is necessary to mix it with the 100 gallons of hard water in one of the compartments p or p^1. This is done by regulating the length of the stroke of the pumps k and k^1, which pump the standard chemical solution from the tank d into the funnel n. These pumps k and k^1 are operated by the tilting vessel p in the following manner: The plungers u are connected to a walking beam v, which is rotably mounted on the shaft w. The ends of this walking beam are connected by means of the chains x, and x^1 with studs x^2 on each end of the tilting vessel. An examination of the drawings, particularly Fig. 3, will show that if the parts are in the position shown in Fig. 3, when the tilting vessel p is tilted dowawardly to the left, the plunger of the pump k is raised so that a quantity of the standard chemical solution is delivered into the funnel n and flows with the hard water into the compartment p^2. When 100 gallons are in it the tilting vessel p operates in the opposite direction, causing the other pump k^1 to operate, and delivers a quantity of the standard chemical solution into the funnel n, from whence it flows with the hard water into the compartment p^1. It will be understood that the hard water is running constantly through the elbow o, and that the two pumps k and k^1 are intermittent in their action. The quantity of the standard chemical solution delivered at each stroke of these pumps is regulated by the length of the strokes. This can be adjusted by the length of the chains x and x^1, so that a predetermined quantity of chemical solution will be delivered at each stroke. From the above description, it will readily be seen that a fixed quantity of chemical solution is discharged into the elbow o, and flows with the hard water into each compartment of the tilting vessel p, in proportion to the amount of hard water that is required to cause this vessel to tilt. It is desirable to automatically and economically operate the vertical shaft g in the chemical tank d (see Fig. 2) so that the horizontal blades attached to it will keep the chemical mixture thoroughly agitated. To do this it is geared to the horizontal shaft w by the pinions y and y^1. The other end of the horizontal shaft w is provided with a sprocket wheel y^2 (see Fig. 3) around which a link belt chain passes, the ends of this chain being attached to the ends of the tilting vessel by the studs y^4. It will readily be seen by this arrangement that whenever the tilting vessel p moves, the stirring blades attached to the vertical shaft g in the chemical tanks also move, thus agitating the chemical mixture in the tank d. For convenience in measuring the height in the tank of this chemical mixture, a pipe z (see Fig. 4) is attached to the side of tank d near its bottom. In this pipe is a float z^1 attached to a graduated scale z^2 from which can be read the quantity of liquid in the tank d.

The above described apparatus automatically mixes the proper quantity of the chemical solution with each 100 gallons of hard water, delivered by the steam pump and utilizes the weight of the water to furnish power to operate it. The result of this mixture is that the scale-forming matter that was in solution in the hard water is thrown out of solution, but remains in suspension in the treated water. This is separated from the treated water in the following manner: By referring to Fig. 6, it will be seen that the apparatus is located in the second story of the pump house, and that the pump house is located between two tanks placed on the ground. Fig. 7 shows a plan of the second story of the pump house. It will be seen from this that the tilting vessel above described empties its contents into a wooden box which is provided with troughs r and r^1, leading to the two settling tanks. These troughs are provided with shut-off gates so that the water can be run into whichever tank is desired. Fig. 6 shows a sectional elevation of these tanks. It will be seen that the troughs r and r^1 empty their contents into vertical pipes that extend to the bottom of the tanks and terminate in elbows. The object of this arrangement is to stir up as much as possible the old precipitate that remains in the tanks from former treatments, in order to hasten the settling of the new precipitate. It is a well known fact that if the old precipitate is stirred up well, the new light particles become attached to the old heavier particles and settle quickly.

After these tanks are filled or partially filled with the treated water holding the new precipitate in suspension, it is desirable that the sediment from former mixtures be thoroughly agitated and mixed in the settling tanks in order to hasten the settling of the new precipitate. To accomplish this result the same steam pump is used that was used for pumping a supply of water into the main. This pump has its inlet connected to branch pipes, leading into each of the settling tanks. These branch pipes have their outer ends 15 and 16 jointed to the main portions thereof, so as to be swiveled thereon. Floats 17 (see Fig. 6) are secured to each of these inlet ends of the branch pipes 15 and 16 to maintain their inlet-openings at or near the level of the liquid. The discharge pipe 11 of such pump is also



connected with branches 19, which extend into each of the settling tanks, and such branches are also connected to perforated pipes 20, which rest at or near the bottom of such tanks. The operation is as follows: The valves on the ordinary inlet and discharge pipes, which are used when the mixing apparatus above described is in operation, are closed, while valves on the inlet and outlet pipes are opened. The pump is then started and the mixed treated water and precipitate at or near the top of the settling tank is drawn into the pump through the pipes, and forced into the bottom of the settling tank through perforated pipes, thereby maintaining a circulation of such liquid in such tanks, and stirring up the sediment from former treatments. After the contents of the tanks have been agitated for a few minutes they are allowed to stand until the sediment has settled. The purified water is then taken from the settling tanks through the pipes, attached to the floats, and transferred to a suitable storage tank, or it may be drawn direct from the settling tanks to the boiler.

The same size apparatus is used for all plants. The capacity of this apparatus is almost unlimited. The number of oscillations of the tilting vessel p is determined by the amount of water that can be pumped into it, so that if settling capacity is provided, the capacity of the apparatus depends entirely upon the capacity of the steam pump. In regard to settling capacity: It has been found by using tanks 30 feet in diameter and 16 feet high, that each tank can be filled with treated water, the precipitate allowed to settle, and the clear softened water transferred to the railway supply tanks in 12 hours. These tanks have a capacity of 77,000 gallons, but as a certain quantity of water is left in these with the sludge, their net capacity is about 60,000 gallons of softened water each 12 hours, or 120,000 gallons per tank per 24 hours.

Once a month it is necessary to remove the sludge that has collected in the bottom of the settling tanks. When the softening plants are located near a drain the removal of the sludge is a very simple proposition. It is then only necessary to open the valves in the bottoms of the settling tanks and allow the sludge to run into the drain.

Up to the present time the only use found for this sludge is for making whitewash. On account of its firmness and freedom from grit, it is especially adapted for use in a whitewash spraying machine.

With this apparatus the cost of treating waters will vary from a minimum of about 1 per cent. 1,000 gallons for a fair boiler water, to a maximum of say 10 cents per 1,000 gallons for a water that is so bad that an attempt to use it untreated in boilers would result in so much trouble and expense as to practically debar its use.

The salient points brought out in this paper are as follows:

1st. Scale, deposited from water, on the inside of boilers, is the cause of much trouble and expense.

2nd. Water as it falls on the earth does not contain any scale-forming matter.

3rd. The amount and character of the scale-forming matter in water varies greatly and depends upon the character of the soil and rock through which it passes.

4th. Scale-forming matter can be removed from water before it is used in boilers by simple chemical processes and inexpensive mechanical apparatus.

5th. Ninety-eight per cent. of scale in boilers is derived from carbonates and sulphates of lime and magnesia.

6th. Carbonates of lime and magnesia are thrown out of solution by boiling. They, alone, form soft scale.

7th. Sulphate of lime requires a boiler pressure of about 55 pounds to throw it out of solution. It forms hard, compact scale.

8th. Sulphate of magnesia is decomposed in a boiler, forming hydrate of magnesia and sulphate of lime. These make a very hard, brittle scale.

9th. Carbonates of lime and magnesia can be thrown out of solution in cold water by adding to the water any chemical that will absorb the carbonic acid gas that holds them in solution. Slaked lime is the cheapest.

10th. Sulphates of lime and magnesia can be thrown out of solution in cold water by decomposing them with various chemicals. Carbonate of soda is the cheapest.

11th. The use of boiler compounds in boilers is not advisable. The proper time to remove scale-forming matter from water is before it enters the boiler.

12th. Hard water that is very poor for boiler use can be softened and made good for boiler use at a cost that is only a small per cent. of the expense of using the hard water untreated.

NEW WATER WORKS OF ST. JOHN'S, NFLD.

An interesting piece of work has been going on during the present season at the City of St. John's, Nfld. During the year 1903, the city council requested John Galt, consulting engineer of Toronto, to investigate into and report on the present system of water supply.

After careful surveys and consideration of the subject, Mr. Galt reported that the 24-in. gravitation supply main from Windsor lake, which was coupled to the two 16-in. mains, was quite unsuited to meet the wants of the city owing to defective gradients along the route, which was naturally very flat, level ground. His recommendations were that the 24-in. main be raised and the water of Windsor lake allowed to flow into and along the rock, cutting a distance of about 3,000 lineal feet. This channel in rock cutting to be mostly covered in and arched over.

At the end of the cutting, a concrete controlling chamber with sluice gates and screen house is being built, from which

Concrete Conduit on Surface.

a concrete conduit about 4 ft. in diameter and about 9,000 lineal feet runs on a uniform grade with several small drops to even up and conform to the ground elevation. This concrete conduit is built partly in deep cutting and partly on fill, as shown by the photo illustration herewith; one of which shows the conduit under construction and carried over on culvert bridge crossing an important stream. At the lower end of this conduit the water is discharged by natural gravitation into a concrete compensating basin provided with independent controlling sluice valves and straight-way bye-pass. A moderate fall from the lake to the compensating reservoir basin, a distance of about two and one-half miles [illegible] capacity if required of [illegible] 15 [illegible] times the present requirements.

The City of St. John's [illegible] rising from the sea level to [illegible] Windsor lake is situated about [illegible] from the [illegible] at an elevation of 500 feet above the sea. [illegible] a long, deep valley contiguous to the city [illegible] it is proposed to run duplicate iron pressure supply mains [illegible] differnt directions to the city. As the old 24 [illegible] iron mains will be reclaimed and raised after [illegible] of new concrete supply conduit towards the lake [illegible] utilizing

Group of City Councillors and Others.—Smith Concrete Mixer in Background.

of same for conducting water across the valley renders the laying of duplicate pressure supply mains a fortunate thing for the city, preventing practically any loss or expense in the connection, while at the same time increasing fourfold the efficiency and supply of the whole waterworks system.

The work, so far, covers generally the improvements and enlargement to the supply, but it is the intention to follow this up by improving the system of distribution throughout the streets of the city proper. The municipal council of St. John's have undertaken the construction of this work by day labor, under the personal attention and management of their city engineer, John Ryan, with Mr. Galt as acting consulting engineer. Considerable money was spent in purchasing the necessary plant, such as steam hoisting derricks, rock crushers

Concrete Conduit in Trench

and concrete mixers. All materials, excepting sand and cement, are found on the site. Mr. Ryan with his staff of assistants and foreman, also with the aid of 100 to about 150 men at different periods, has made excellent progress and done splendid work. Although starting late in the season, or about the

1st of July, the entire excavation has been completed and nearly all the concrete conduit built.

It is expected that before the season closes most of the concrete work, the conduit screen house and the compensating basin will be finished. Next year work will be confined to the canal at Lake end, also the laying of iron pressure mains across valley towards the city. The illustrations are from photos taken in September by James Vey, of St. John's.

TIDAL POWER.

The utilization of the tide for "power" purposes has long been an object that inventors in one way or another have sought to attain. A Manchester inventor, James Howarth, now claims to have completely solved the problem of utilizing the rise and fall of the tides, and other naturally elevated water, for commercial purposes; all that is wanted, in his view, being the requisite financial assistance for the introduction of the machinery and works for carrying out his project. What he proposes is to utilize the rising of the tide in compressing air. This is not by any means a new idea, but the method by which Mr. Howarth claims to have solved the problem of utilizing the pressure of the tide and of inland waterfalls possesses features of novelty, and may best be decribed in his own words. The essential feature of his scheme is the construction of a number of chambers in suitable positions to which the tide has access, and, entering the bottom of these chambers, the air is compressed as the water rises. He claims that a twenty-four feet tidal rise would give over 10 lbs. per square inch pressure, and that one acre of beach surface of this rise would supply over 1,900 h.p. The compressed air is to be transferred into receivers situated on shore, through pipes. Pressure-impressed water is used as an intensifying medium, the pressure being impressed by the tidal rise, and air and water are pressure impressed ultimately as the process proceeds. The chambers are to be in series, the first receiving chamber storing 100 h.p. per head surface feet deep, and being 100 feet deep it contains 10,000 h.p.; the next chamber is to store 100,000 h.p., and the third 1,000,000 h.p. The storage chambers are all to be of equal size, but all of very different strengths, the pressures of these being, respectively, 10, 100, and 1,000 lbs. per square inch. The head plate surface of each is to be about 2,300 square feet, so that a third chamber in ten times larger size would store 10,000,000 h.p. with a pressure of 1,000 lbs. per square inch, although starting with only 10 lbs. of tidal pressure per square inch. In this arrangement it is claimed that the only mechanical power lost is that caused by friction, which is comparatively a mere fraction to the general loss in steam-using machinery. The quantity of horse-power storable per tide would, of course, be in proportion to the beach surface covered and the height of the local tide combined from which the power was to be drawn. The inventor submits that enough tidal power might be drawn from the British tidal coast to equal all the steam-engine power employed in Great Britain, including that of railway and tramway propulsion, if converted into electric driving power. Also, that his system of power utilization could be equally well applied with the most useful effect possible to waterfalls of any height, or to streams of not less than twenty feet descent from any near point of working.—Marine Engineer.

GAS ENGINE PROBLEM.

At the last meeting of the British Association for the Advancement of Science, held at Cambridge, Dugald Clerk gave the results of some experiments which, according to one of our English contemporaries, "marks another step in the progress of the internal combustion engine."

Mr. Clerk's paper is entitled "Flame Temperatures in Internal Combustion Motors," and his analyses of other experiments and those of his own establish several important facts, the salient ones of which may be stated as follows: If the density or pressure of the charge of an engine before compression be increased, the maximum and mean pressures may be increased without increasing the flame temperature; from which it follows that the mean pressure may be maintained the same as when the charge is drawn in at atmospheric pressure and the flame temperature reduced. It is also established that the heat loss to the enclosing walls of an explosion chamber does not increase in proportion to the increase of pressure or density of the gaseous mixture before explosion.

It is thus seen that engines may be made much more powerful for a given cylinder diameter, and cylinder losses may be greatly reduced, not only by the increased density, but by reduced temperatures capable of giving the desired pressures.

Mr. Clerk simply states the above facts, but their truth is easily grasped if we consider that an increase in the suction pressure increases the compression pressure and the heat generated by the combustion will raise this pressure a given amount. This heat is also applied to raising the temperature of a greater weight of gas, however, and if its specific heat remain constant, which it practically does, the maximum temperature will not be as high as if the suction pressure was normal, or in other words, the temperature will be reduced. The mean pressure is augmented by the added suction pressure inasmuch as the exhaust is into the atmosphere.

The author describes his experiments on gas engines in detail and the results show an increase in thermal efficiency of from 28.7 to 34.4 per cent. and a reduction in the maximum temperature of from 1,700 to 1,200 degrees centigrade; this in the case of an engine using an added charge of air compressed by an auxiliary compressor driven by a belt from the flywheel of the engine.

The suction pressure in another experiment was increased by introducing a portion of the exhaust gases cooled into the cylinder and so gain the higher pressure and density without the aid of an auxiliary air pump. The results showed a performance considerably above the best ever recorded for an engine of that type; the brake horse-power was increased by 5, and thermal efficiency from 28.7 to 32.5 per cent. and the temperature reduced to 1,300 degrees Centigrade. These advantages induced the National Gas Engine Company to build a 300 horse-power engine to carry out this fundamental idea of reducing flame temperature while increasing mean pressures. In this engine the head end of the cylinder is arranged as an ordinary four-cycle motor while the crank end is arranged as an air pump, and is enclosed with a cover through which the piston rod passes. The piston on its outward stroke overruns a series of ports placed around the cylinder and through which the compressed air charge is inserted. The success of this engine is that of the others and more; a mean pressure of over 100 pounds per square inch is obtained with the very low maximum temperature of 1,200 degrees centigrade.

Notwithstanding the fact that the piston of this engine was not water cooled, it ran with full load, with consecutive admissions, at 160 revolutions per minute, the cylinder diameter being 21 inches and the stroke 34 inches.

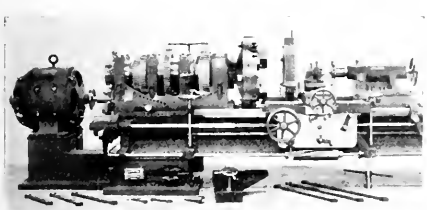
That the increase in thermal efficiency is a matter of secondary interest is best shown by the author, who says:

"The difficulties with which the large gas engine is at present struggling are in main due to the high temperatures of the flame in the interior of the cylinder. So long as high-temperature flames are used within cylinders of relatively small dimensions, the difficulties due to unequal expansion of parts does not appear. The steam engineer is well aware of the care which has to be exercised in using large steam-cylinders in such a way as to avoid cracking, and he can quite well imagine that the difficulties of allowing for free expansion in a gas-engine cylinder are much more serious than his own when he considers the relatively low temperature of his steam. Even with superheated steam, 300 degrees centigrade is a fairly high temperature, while in existing gas engines of either large or small types it may be taken that the lower limit of maximum temperature at present is nearly 1,400 degrees centigrade. The water jacketing of a moving piston is an admirable expedient most carefully and ably carried out by many Continental and English engineers; but it is an expedient which has never satisfied me, and is, I believe, regarded with distrust by a considerable number of English engineers. In my view many of

the troubles which have been experienced with large gas engines—cracking pistons, back covers, and the like—are due to the difficulties introduced of getting rid of very large heat flow through cylinder and piston walls, and it appears to me desirable, if possible, to reduce this flow to the lowest point consistent with maintaining the economy of the engines. In doing this, of course, it will not do to reduce the mean pressures of the engines. Large gas engines are at present undesirably heavy for the power, as compared with steam engines, and it will not do to increase the weight in any way by reducing the temperatures. This plan of artificially raising atmospheric pressure, either by the addition of air under pressure or by the addition of cooled exhaust gases under pressure, appears to me to furnish a very promising solution of the problem. In gas engines operated with producer gas or blast-furnace gas, the question of maximum possible economy is not at present a pressing one. The thermo-dynamic efficiency of all gas engines is now so much greater than any heat efficiency attained in steam engines that we can well afford to reduce economy, if need be, in order to make more certain of good practical results—that is, to make more certain of low cost for upkeep and repairs. In my view it would pay in large gas engines even to reduce fuel economy if by so doing entire immunity from breakdown was secured. So far the best means of limiting temperature in a simple way appears to be found in the addition of cooled exhaust gases to the charge before compression; and this method, although reducing flame temperature, has actually increased the efficiency instead of diminishing it."

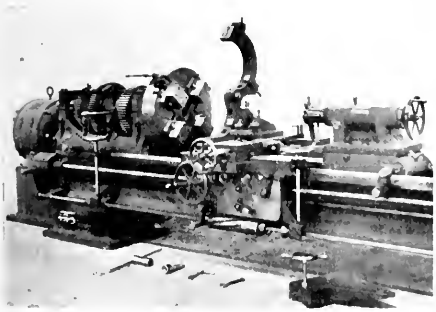
SPECIAL LATHE.

The Lodge & Shipley Machine Tool Co., of Cincinnati, have recently installed a special lathe in one of the projectile shops of the United States. Its novelty consists in its simplicity.



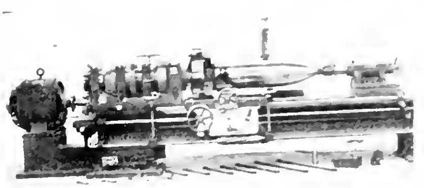
Projectile Turning Lathe.

The motor used is a Ridgeway 15-h.p. with speeds of 350 to 1,750. The controller has 20 speeds, and is, as shown, operated from the carriage, or at the head stock. The ratio of back gearing in the head is 1.62 : 1 and 2.62 : 1; the ratio of the motor shaft to the live spindle is 7.48 : 1 and 15.1 : 1. All gear-



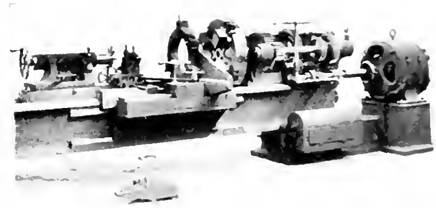
Projectile Turning Lathe—Side View.

ing in the head, that is, the main driving gears, are cast iron centres, with machinery steel rims of extra width. The size of the spindle bearings are: Front, $7\frac{7}{8}$-in. diameter by $8\frac{3}{4}$-in. Back, $7\frac{1}{2}$-in. by $5\frac{5}{8}$-in. The spindle is of crucible steel, .55 carbon; the hole through the spindle is $2\frac{3}{8}$-in. diameter. The lathe is designed at minimum speed of [illegible] r. [illegible] cutting speed for roughing on the body of the shell of [illegible] ft. per minute and for finishing of 60 ft. per minute. It will be seen that the



Projectile Turning Lathe.

milled cylinder on the speed control shaft, immediately under the apron, provides an automatic mechanical and full electrical speed variation for varying diameters, so that the cutting speed may be continuous from 2 inches diameter up to the largest diameter. The tool post is of steel. The special steady rest is quickly applied and removed, and the radial attachments



Projectile Turning Lathe—Rear View

furnish several desired curves. The chuck is of a most massive and substantial design. The diameter gauges shown on the nose of the tailstock are in practice great economizers of time. This lathe is of 27-in. swing; the length of bed can be varied to suit the customer, the lathe shown having a 14-ft. bed.

GEORGIAN BAY ENGINEERING WORKS.

The Georgian Bay Engineering Works, Midland, Ont., are manufacturers of the "Midland" gas and gasoline engines. These engines which are very simple in construction have rapidly come to the front, and as will be seen by this firm's advertisement in another page, are suitable for connecting with generators for electric lighting, etc. Besides stationary, marine and portable gas and gasoline engines, this firm makes engines and boilers of all kinds, contractors' hoisting engines, mine hoists, steam pile drivers, and general contractors' plants, as well as the "Midland" band saw wheel grinder, which has just been put on the market. As the company's shops are situated at the water's edge, and there is 20 feet of water in their slip, it is very convenient for boats needing repairs to go there. They are in a position to make a strong bid for this class of work, being equipped with compressed air and electric plants. They have just completed a fine Corliss engine for their own shop, as the immense increase in their business necessitated more power. They are prepared to duplicate this engine on short notice. They have several contracts closed for their boiler shop, and are just completing a fine little marine boiler to carry 200 lbs. pressure. They also have a contract under consideration for a 30 foot steel launch, to be fitted with one of their "Midland" marine gasoline engines. This yacht is to have a guaranteed speed of 23 miles per hour, and they are open to turn out speed launches with a guaranteed speed. Plans are under consideration for the extension of the business, and building operations will be commenced as soon as possible. The manager of the Georgian Bay Engineering Works, G. W. Thexton, is an expert in his line, and was connected for some time with The Canada Cycle & Motor Co., and also with Nathaniel Herreshof, the designer of most of the defenders of the America Cup.

"YANKEE" AUTOMATIC DRILL.

Hand drills have never been entirely satisfactory for general use. The trouble has been that no one strength of spring in these tools would be satisfactory in both soft and hard woods, or for the large and small drills furnished with the tool. The best that could be done was to use a spring of average strength.

In a new drill put on the market by the North Bros. Mfg. Co., Philadelphia, this difficulty has been overcome by a device to adjust the tension of spring, making it weaker or stronger according to requirement of character of wood to be drilled and size of drill to be used. The cap on top of drill has a screw attached to it, by revolving which the spring is made longer or shorter, thereby making the spring weaker or stronger. The spring is held at desired tension by a small bolt or lock which

engages in the cap and is operated by a small knob on side of handle. The method of operating is described in a leaflet published by the company. The tool is nickel plated and finely finished. The material and workmanship are of the best.

Eight drill points are furnished with each tool. The entire length of tool, inclusive of drill point, as in illustration, is $11\frac{1}{4}$ inches.

STEAM HAMMERS VS. DROP HAMMERS FOR PILE DRIVERS.

A committee appointed by the Association of Railway Superintendents of Bridges and Buildings, of the United States to deal with the above system has presented a majority and minority report. The majority state that the superiority of the steam hammer for some classes of work, such as foundation work under buildings, piers, etc., is apparent; while for road work, those who are using steam hammers would not exchange them for drop hammers under any circumstances. The committee believes the steam hammer is the best type of hammer for all kinds of pile driving, and when used with a bonnet makes pile driving a comparatively easy job. Piles can be driven without injury to the pile in almost any kind of earth with a steam hammer, where it would be rent from head to point by a drop hammer. The pile is held much more firmly under the steam hammer, and is guided home in much better fashion than can be accomplished with the drop hammer; besides there is not the injurious strain upon car and machinery that is felt from the drop hammer.

The cost of maintenance is much less for the steam than for the drop hammer, and the cost of driving piles is also much less. The first cost of the steam hammer is, of course, much greater, but it is a good investment notwithstanding. The size of the steam hammers may vary for different kinds of work the No. 1 for foundation work and the No. 2 for road work, though some prefer the No. 1 for all classes of work.

The majority members were firm, and the minority one who held that for driving in hard clay the drop hammer was best. He adds:—"I think, also, that a drop hammer is more convenient to handle than a steam hammer, in a road driver, as the steam hammers are so very heavy that the driver needs lots of counter weight to balance them when it is swung. Also, they are so long that very long leaders must be used in order to get piles under them, and with a heavy hammer at the top of the long leaders the machine is very likely to tip over on the track with much elevation or a track which is very much out of surface, as the tracks frequently are where work is being done. If I could only have one hammer for general railroad pile driving I would prefer a drop hammer to a steam hammer, as I think the work in general can be done cheaper, everything considered, with a drop hammer than with a steam hammer. I understand, of course, that a steam hammer is very desirable in some kinds of work, but for a single hammer I would prefer a drop hammer. In regard to using a bonnet with a steam hammer, this same piece of head gear can be used fully as well with a drop hammer, and will take up proportionately less of the energy of the blow of a drop hammer than of a steam hammer."

Another member reports his own tests which were in favor of the steam hammer. He says:—"I believe everything is favorable to the steam hammer, with the additional advantage that it does not damage the pile on the end, and does not require it to be banded, which saves considerable money in this direction. It makes no difference where the head of the pile is in the leads with the steam hammer. It is just as effective one place as another. The longer the piles in the leads the less the drop of the hammer and less effect the hammer has on the pile. We can drive four piles with it against two with the drop hammer."

A SUCCESSFUL MOTOR CANOE.

Editor Canadian Engineer:—

Sir,—Great interest is maintained in the development of small motor craft, and while there are many classes of motor boats, so far as we know the motor canoe described here is the first that has been a success in actual practice.

It is an ordinary stock paddling canoe, 18 feet long, 35 inches beam, 14 inches deep, built by The Canadian Canoe Co., Peterborough, and as shown in photo, there is built on from about the centre of the keel to the stern a "skeg," through which the shaft runs to a point sufficiently low to keep the propeller submerged under all conditions, which as far as I can find out was the main difficulty experienced by others. This "skeg" not only answers the purpose mentioned, but also provides a good long bearing for the shaft, and stiffens the canoe considerably. It is fastened through by

bolts sufficiently long to be riveted underneath to the 1 inch half-oval iron which serves as a protection to the keel, and is carried from the bow to the stern, at which point it projects as a shoe protecting the propeller blades from injury either while running or landing. The rudder is attached to this shoe, and steering can be controlled from any part of the canoe, as an endless cord runs through screw eyes and pulleys attached to the gunwales. Motive power is supplied by a two cycle, single cylinder, 1-h.p. gasoline engine, set up exactly in the centre of the canoe. It is fastened to a bed made from two 4 foot pieces of ash, laid longitudinally, with two cross pieces formed to fit the shape of the bottom of the canoe. These pieces also act as braces, and are fastened from the outside by brass screws. The propeller shaft from the engine to the "skeg" is encased in brass tubing, and is supported by two bearings about two feet apart. This stationary casing also acts as a bearing where it enters the "skeg," and the shaft can always be kept lubricated, and notwithstanding the 9-foot length of the shaft there has been no side play. The gasoline tank, (capacity 3 gallons), is in

the bow under the decking, and a lead pipe conveys the gasoline to the carburetor. This worked all right in smooth water, but where rough water is the rule I advise cylindrical tanks placed amidships. Battery box, spark coil, and switch, together with the connecting wires are waterproof, and are within easy reach of the party running the engine. The discharge pipe from the water jacket is run through the muffler. A tool box is used as a seat by the party running the engine, and while one person can easily operate the canoe I found that with carrying two or three people better speed could be obtained. Four adults can sit comfortably in the canoe, and an average speed of a little over 10 miles per hour during the past season was obtained with the equipment described.

The cost of the canoe equipped is about $180, and when fully loaded the draught is less than 12 inches.

It is impossible in a short description to give details,

but I am confident that this type is not only the ideal one for pleasure seekers, but that it will also appeal to prospectors, explorers and surveyors, who need something portable, safe, speedy, and strong enough to stand hard usage. As an illustration I may state that in August with fairly choppy water, on Lake Ontario, we carried in the canoe four adults and two children, and towed for several hours an 18-foot row boat containing as many more people. I found the canoe very steady in the roughest weather, easily steered, and quite dry.

Those interested and who wish to build can get further details by writing to me, and I can also arrange for working plans and specifications. A. E. Dunn, St. Enoch's Square, Toronto, did the necessary wood work, and the engine was designed by E. J. Philip, now of Brandon, Man., and was installed by the Dominion Motor & Machine Co., Toronto. William Wilkinson, one of the employees, successfully solved some intricate problems in connection with the gasoline supply, which on account of the limited head afforded by a craft so shallow proved difficult.

ARCHIBALD W. SMITH.
75 Collier St., Toronto, Canada.

THE LARGEST TROOPSHIP IN THE WORLD.

The largest troopship in the world, the "Dufferin," was recently launched at the yards of Vickers, Sons & Maxim, Limited, Barrow, England. The dimensions of the vessel are: Length over all, 453 feet; breadth, 52 feet 6 inches; moulded depth, 39 feet. She is of the spar deck type, having four complete decks, and a boat deck about half her length amidships. Under the main deck the vessel is divided into a number of water-tight compartments, which are controlled from the bridge, and can be closed in a few seconds, making her practically unsinkable. Particular attention has been paid to the ventilation [illegible] vessel, and electric fans [illegible] natural draught. She [illegible] The propelling machinery consists of two [illegible] inverted vertical, direct-acting, triple expansion engines, each set [illegible] three cylinders, working on separate [illegible] and capable of developing 9,400 i.h.p. at 115 r.p.m. The cylinders [illegible] in., 47 in. and 75 in. respectively, with a stroke [illegible] Steam is supplied from four double-ended boilers of the multitubular type, each fitted with six Morison's [illegible] furnaces, and carry a pressure of 180 pounds. The equipment of the vessel is equal in all respects to that of a first-class liner, and everything is provided for the comfort and health of the troops, of which she will accommodate 1,500. If necessary she can be quickly converted into a cruiser, as she carries eight 4.7 and eight three-pounder quick-firing guns.—Marine Engineer, London.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

The following is a list of members elected in the various classes at the meeting on 17th November:

Members.

Charles Evan Fowler, of Seattle, Washington. Francis H. Leonard, Jr., of Montreal. Francis C. McMath, of Walkerville, Ont. William James Stewart, of Ottawa, Ont.

Associate Members.

Ernest Burchell Bartlett, of Quebec. Henry Stanley Carpenter, of Gamebridge, Ont. William Hugh Coverdale, of New York. Alexander McIntosh MacGillivray, of St. Margaret's Bay, N.S. Martin J. Murphy, of Halifax, N.S. George Phillips, of Esquimalt, B.C. Francis Alexander Pickering, of Halifax, N.S. Owen Phillipps Schreiber, of Ottawa, Ont. Thomas Taylor Simpson, of Deschenes, P.Q. David Rees Thomas, of Rossland, B.C. Robert Mauson Wilson, of Montreal, P.Q. Charles Osborne Wood, of Billing's Bridge, Ont.

Transferred from the Class of Associate Member to the Class of Member.

Basil Hall Fraser, of Ottawa, Ont. Arthur Edward Hodgins, of Johannesburg, South Africa. Frederick Perry Shearwood, of Montreal.

Transferred from the Class of Student to the Class of Associate Member.

John Lorn Allan, of Halifax. Arthur C. D. Blanchard, of Niagara Falls, Ont. Harold Langmuir Bucke, of Thunder Bay, Ont.

Associate.

Thomas Arthur Morrison, of Montreal.

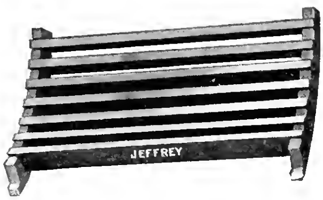
Students.

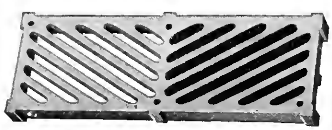
Augustine Bradt, of York, Ont. Leonard M. Bidwell, of North Bay, Ont. Paul Albert Beique, of Montreal. Charles Frederick Bristol, of Montreal. Alexander I. M. Bowman, of Montreal. Harry Gordon Budden, of Montreal. Edward Leroy Burgess, of Ottawa. Austin Lewis Cumming, of Cornwall, Ont. Ernest Frederick S. Dawson, of Charlottetown, P.E.I. James Vidal Dillabough, of North Williamsburg, Ont. Kenneth William Dowie, of Lachine, P.Q. George Patrick G. Dunlop, of Montreal. William Milton Edwards, of New Liskeard, Ont. Thomas Urquhart Fairlie, of Kingston, Ont. Delmer Clinton Findlay, of Montreal. J. R. Freeman, of Brooklyn, Queen's County, N.S. Albert Coleman Garner, of South Qu'Appelle, Assa. George Ackland Gillies, of Carleton Place, Ont. Harold St. George Hamersley, of Vancouver, B.C. John Handley, of Ottawa, Ont. Ernest Stillman Hill, of St. Stephen, N.B. Victor J. Kent, of Fort William, Ont. Royal Lesage, of Montreal. Douglas Clement Livingstone, of Montreal. Fred Hunder Lytle, of Toronto, Ont. Thomas Clarkson McConkey, of Guelph, Ont. John J. Macnab, of Montreal. John Goodwill MacPhail, of Niagara Falls South, Ont. Pierre Adolphe Masson, of Montreal. Sydney Albert Meade, of Sherbrooke, P.Q. William Charles Meyerstein, of Montreal. Henry Belfrage Miller, of Montreal. Herbert Harrison Moore, of Deer Park, West York, Ont. Arthur McIntyre Morrison, of Dartmouth, N.S. John Eric Newlands, of Montreal. Emile D. Normandeau, of Ottawa. Fredrick Hatheway Peters, of London, Ont.

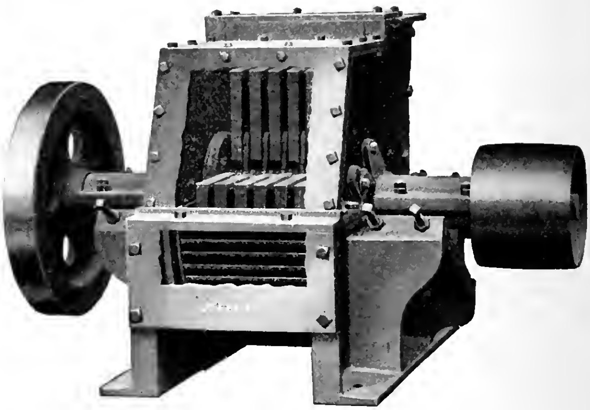
Archibald McEachren Phillips, of Ottawa, Ont. Alfred Allan Putnam, of Halifax, N.S. Arthur Reginald Roberts, of Montreal. Peter Albert Shaver, of Grantley, Ont. Joseph Drummond Shepley, of Leamington, Ont. John H. Sills, of Belleville, Ont. Duncan Sinclair, of Toronto, Ont. George Singers, of Montreal. Richard Henry Smith, of Sydney, N.S. Richard Lane Squire, of Kingston, Ont. Guy Tooker, of Montreal. Arthur Vincent Trimble, of Toronto, Ont. David Thomas Townsend, of Woodstock, Ont. George Edward Vansittart, of Toronto. Horace Walker, of Kingston, Ont. Alexander Thompson Wilson, of Moncton, N.B.

JEFFREY HAMMER PULVERIZER.

The manufacture of this type of pulverizer has recently been taken up by the Jeffrey Manufacturing Company, of Columbus, Ohio, being under the Schoellhorn-Allbrecht patents acquired by it. The first illustration shows the pulverizer with its interior or crushing parts; the others show the sectional screen frame, which is one of the special features in this machine. It is designed for crushing and pulverizing material such as coal, clay, shale, rock and many other materials. The manufacturers claim it to be the simplest machine of its kind made. Strong features are its simple beater hammer, its "V" shape bar screening surface, its simple adjustment of the beater arms to accommodate wear, its substantial adjustable dust-proof pillow blocks, its top feed hopper insuring large capacity and permitting material to be partly crushed while in suspension; all of which go to make this machine as nearly perfect as can be made. The accessibility of its inner parts is also one of its strong features. The taking off of the rear plate and the hand-hole plates on the side of the machine make it possible to change the beater arms as well as the screening surface when necessary. The screening surface is made up in sections, so that it is the work of but a few moments to take out or change from one size mesh to another. Many of these machines are in use so there is no experimental period to be gone through with. It is made in many sizes to suit the various requirements, for instance in coal the capacity varies anywhere from fifty to one hundred tons of coal per hour depending entirely upon the degree of fineness. In pulverizing material such as rock, its capacity is any where from a ton to twenty-five tons per hour. The "Jeffrey" Company make free crushing tests for interested parties thus demonstrating before sale, what the machine is capable of doing. Complete catalogues on this subject can be had by addressing the manufacturer.







Willard N. Sawyer, of Pittsburgh, has been appointed general manager of the Soo industries, in the place of the late Cornelius Shields, whose untimely death was noted last month. Mr. Sawyer is a steel expert and contractor, and a member of the firm of Wellman, Seaver & Morgan, one of the largest engineering firms in the United States.

BOILER FEED WATERS AND SCALE.*

BY A. M. WICKENS.

I may say that after having spent my whole lifetime in connection with engines, boilers and steam plants generally, as an erecting engineer, as an operating engineer, and latterly as an inspector, I have arrived at some conclusions that are very strongly impressed upon my mind regarding feed waters, scale and other troubles that are met with continually in all steam plants. In many of our factories, the boiler part of the outfit seems to be the part of the whole establishment that receives the least consideration or attention, by the owner or manager. A steam boiler is not a very handsome-looking piece of apparatus; it is generally associated in the owner's mind as a miserable, dirty affair, buried in brick, soot and ashes, and with the assistance of the architect of the building, it is relegated into some dark, out-of-the-way place in the basement, crowded and pinched for room. No adequate means is provided to keep it clean, either inside or outside. This, to my mind, is very strange, because as a matter of fact, the boiler in reality is the heart of the whole establishment and the source of all the mechanical motion required in the factory and should have every advantage that ingenuity and carefulness can afford. Where boilers have been thus treated, the subsequent treatment of them is usually of a very poor and meagre character, and the result is a short and wasteful life. We have many forms or kinds of waste going on all the time in connection with our boilers, some from faulty construction or defective setting, some from bad chimney draft or bad management of the fires or from bad fuel, others, and many of them, from the use of bad feed waters and a collection of mud, soot, ashes and scale. If we expect good results and economical work, we must see that the surfaces of the metal are perfectly clean, both outside and inside. If we allow the outer portions of those exposed to the fire to become covered with soot and ashes, we have applied one of the most efficient non-conductors of heat known to science. Again, if we allow the interior of the metal to become coated with scale, mud or sludge, we have added another first-class non-conductor. The same applies to oil being allowed to gather in the metal with the added difficulty that the oil will surely make the rivetted joints leak. The efficiency of a boiler is the amount of heat the metal will transmit from the fire and hot gases to the water, and a well set, well fired, clean boiler will utilize from 70 to 75 per cent. of all the heat given off by the burning coal, consequently it behooves us to do everything possible to keep up to that standard.

All waters carry more or less mineral, earthy and organic matter, some of them are charged so heavily that they cannot be used for boiler purposes. Taking the evaporation of 34 lbs. of water per hour to represent one horse-power, a 100 horse-power boiler would need for a day of 10 hours 34,000 lbs. of water, this would be 3,400 gallons and as each gallon of water carries a certain amount of mineral or other matter that will

*A paper read before the Canadian Society of Chemical Industry, Toronto.

not evaporate, we soon, even with the best of feed waters, accumulate scale-making material in our boilers. A feed water carrying from 20 to 40 grains of solid matter per gallon, may be called a good water for use in boilers. In the boiler above, if we have 20 grains to the gallon, it will deposit 50 lbs. per week of sixty hours' run, using three for the specific gravity of the scale, it would cover 250 square feet of the surface to a thickness of .0144 inch or 1-16 inch thick per month; with waters carrying more solid matter the deposit would be proportionately greater. From this you can readily conceive how quickly scale would form over the whole surface of the boiler below the water line. There have been many experiments and tests conducted to determine the loss in heat caused by scale of different thickness and different compositions. It is now generally accepted that hard scale 1-16 inch thick requires from 10 to 13 per cent. more fuel, and that as the scale thickens the extra fuel required also increases until at a thickness of ⅜-inch it is 40 per cent. In our river, well and lake waters, we have principally, as scale-forming matter, carbonate of lime, sulphate of lime, carbonate of magnesia, and some silica with traces of other solids, to deal with. The carbonate of lime, chemically speaking, is chalk, selenite, marble, and limestone, and is held in solution in the water; by an excess of carbonic acid, this is driven off by heating the water and the carbonate is precipitated. A portion of all scale-forming matter floats upon the water in the boiler, while it is making steam, and only settles when the boiler is at rest. This is more particularly the case, when the water contains magnesia. The precipitated particles are carried with the water as it circulates in the boiler, and part of it will lodge in the stillest places, consequently, we have some parts showing thicker scale than others. We also find that the scale is always heavy near the discharge from the feed water pipe; this is because the incoming water soon receives heat enough to precipitate part of the solids, after it mixes with the hotter water in the boiler. Carbonate of lime and carbonate of magnesia deposit a fine powder and form a sludge with the water, but they also often solidify in combination with sulphate and form a very hard and tenacious scale. It is a decided advantage to all boilers to be fitted up with a surface blow-off, that all floating matter upon the water may be blown off frequently; this should be done, at least twice a day. A very hard thin scale, 1-64 inch or less in thickness of sulphate of lime, that is fast to the plates, will not be a detriment to the steaming of a boiler; the disadvantage of it is that it makes a good foundation for other scale-forming matter to build upon, and soon gets to be too thick. We frequently notice upon breaking a piece of scale that it is composed of different layers, all of different thicknesses and colors, and interspersed with thin layers of earthy matter. The face of this incrustation next to the plate is very often of a black color, and adhering to it is found a thin film of oxide of iron. The plate in all these cases bears unmistakeable signs of wasting away; this is caused where the water carries iron salts, and in brackish water it is the chloride of magnesia which will attack the metal of the boiler very quickly. The circulation of the water in all boilers, while making steam, is continuous, and it is quite rapid from the hottest places, thus carrying scale-forming precipitates to cooler places and depositing them in the stillest spots; this helps the life of the boiler and assists in keeping the part that evaporates the most water the cleanest. All boilers generate twenty times more steam immediately over the grates than at any other point, thus making the ebullition so great and the circulation of the water so rapid, that most of the precipitates are carried away and are lodged in the portions of the boilers where the circulation is slow. We usually find scale between the tubes upon the boiler heads, upon the sides of the boiler opposite the tubes, and upon the tubes. We very seldom find any upon the active portions of the shell, that is, immediately above the fire or grates; when it does appear there, we soon need the services of the boiler-maker for repairs. Sometimes we find a pile of loosened scale directly over the fire; this is caused by pieces that are too heavy to be carried away by the circulation, dropping down from the tubes; several of them lie close together, and the lighter pieces in floating by lodge with them, then some clay or silica stick to them, and we soon have a mass. This packs closer and closer until it is close enough to keep the water from the sheet, and the result is the sheet becomes red hot; the steam pressure then forces the sheet outward and makes a bulge or buckle. If this action goes on long enough, the sheet stretches at the apex of the buckle, until the thickness is reduced to such an extent that the pressure ruptures the sheet, hence an explosion, such as occurred at the Toronto Bolt and Forging Works on Sep. 14th of this year.

Again, we have scale forming in such quantities upon the tubes that the passages between them are entirely blocked; this retards the circulation to such an extent that the efficiency of the boiler drops from 50 to 60 per cent., and means that no amount of fuel will get the power out of the boiler, and it also means ruined boiler heads, and flue ends, and an astonishing bill for repairs. The effects of heavy scale are first of all an increase of fuel required, next the shortening very materially the life of the boiler with attendant repairs, accompanied all the time by a liability to a bad rupture or serious explosion. There are a large number of of boiler compounds or purgers, some of them lauded as a cure for all kinds of sediment and scale, and they are composed of nearly all kinds of foolish mixtures, some of which are very injurious to the metal; in fact, some of them will attack the metal and leave the scale entirely alone. The principle or base of many so-called compounds is common soda and soda ash. Tri-sodium phosphate, caustic soda, and concentrated lye, chloride of barium catechu, nut galls, tannic acid and sal ammoniac, and even hydrochloric or muriatic acid, and to assist these some kind of slimy substance is added to prevent the scale from adhering to the metal. These are Irish moss, potatoes, oil, linseed, sugar, molasses and other similar ingredients; some of these mixtures are surprising, and it is a wonder they do not clean out the boiler, engineer, scale, and all else about the factory. Some people will spend several hundreds of dollars per year for compound, and say: Well, we are doing all we can to keep our boilers clean, whether the compound is really just what is needed or not; others will not use anything, but spend money every three or four years to clean the boiler by removing the tubes, scaling off the shell, cleaning tubes, and replacing them. No matter which method is adopted, it is expensive, but if studied out carefully the fixed cost should not be great. An ordinary return tubular boiler well taken care of and using good water will last for thirty years and be safe the whole time, while if the water be bad, and the care worse, ten or twelve years is all the life we can expect to get out of them. Whether we will or no, all our waters have more or less scale in them, and we have, therefore, to do something to counteract it. All scales can be modified by some treatment, either in the boiler or while on the way to the boiler, or in the tank or well, before being pumped to the boiler. The first, by some suitable solvent; the second, by treatment in heaters in which enough heat is applied to precipitate the scale-making properties, and the last by chemical treatment before the water enters. Modern practice in large plants is adopting the last very generally, and water-softening plants for steam boilers are becoming common. These cost from \$3 to \$5 per horse-power for the apparatus, and from 1 to 2½ cents per 1,000 gallons for chemicals, and are proving to be a paying investment in many large plants. We meet another very serious trouble in many of our boilers in the shape of oil. This occurs more particularly in plants where exhaust steam from engines and pumps is utilized for heating buildings or other purposes, and the water of condensation returned to the boiler. There is nothing that will ruin a boiler or reduce its efficiency so quickly as a thin film of oil combined with some of the solid matter in the water. As a result of recent experiments, Sir A. Durston says, although too often neglected, grease and greasy water have a very dangerous influence on boiler plates, because grease being a bad conductor greatly checks the transmission of the heat. With a layer of grease, however thin, upon the boiler plates, although the temperature of the furnace may be no higher than before, the heat cannot pass out of the plates at the same rate at which it is received, and over-heating ensues. He conducted experiments with tubes and found that by a thin coating of grease, the decrease in the efficiency reached 11 per cent. He also found that in an experimental boiler the temperatures next the water were, with a clean plate 430 degrees, and with a greased one 617 degrees, or 187 degrees higher, thus showing the great loss upon the greasy plate. In practice we meet grease or cylinder oil in boilers, and always find it accompanied by leaky joints and tube ends, also by buckles and waves upon the bottom of the boilers if it settles. Oil can always be prevented in boilers

by suitable separators and filters, consequently we should not be troubled by this difficulty. In conclusion, I may say that if we use our boilers well and accord to them the same amount of carefulness and study we do to the rest of our factory, they would last longer and give us more economical service, and we would not have to lie awake o' nights wondering what that old boiler will do next.

THOMAS S. CLARKSON SCHOOL OF TECHNOLOGY.

The Clarkson School of Technology, of Potsdam, N.Y., exhibited several features of its work at the Louisiana Purchase Exposition, St. Louis. The exhibit comprised six hundred sheets, ranging in size from 8 by 10 inches to 22 by 28 inches, illustrating the written and graphic work of the students as regularly executed in the several courses of instruction. It included the subjects of chemistry and chemical engineering, physical and electrical laboratory work, courses in home science, elements of mechanism, mechanical drawing, machine drawing and design, descriptive geometry, electrical charts and diagrams and shopwork exercises. The work of the School was further exemplified by bound volumes of catalogues, circulars, sets of administrative blanks, photographs of laboratories and workshops, etc. Nine bound theses were sent, embodying some of the original research work of the School in civil, electrical and mechanical engineering.

The International Jury in Group III., Higher Education, Technical Schools, etc., awarded a bronze medal to this School. De Lancey M. Ellis, director of Education and Social Economy, said the exhibit was warmly commended by the members of the jury, and was a source of interest to visitors throughout the summer.

STATE RAILROADS IN VICTORIA.

Thomas Tait, formerly superintendent of transportation for the C.P.R., now has control of the State railways of Victoria, Australia, and has recently made his first annual report, showing that for the first time in fifteen years the Victorian railways have paid their way. His report is thus summarized by the News:

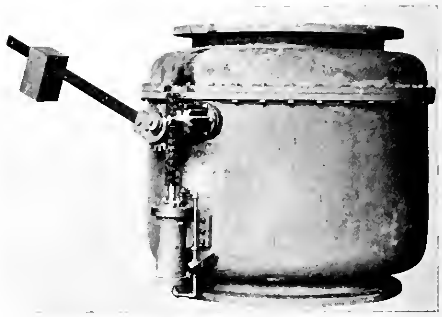
When Mr. Tait went to Australia, the railway conditions in the State of Victoria were about as bad as they well could be. He found himself in a position where it was essential that he should grapple immediately with all those objectionable conditions to which twenty years of mismanagement had given rise. Mr. Tait, for example, found himself confronted with a railway system, having numerous branches, that had not paid at any time, and could not be expected to pay for many years to come—a situation that had resulted for years in a loss of £1,000 a day. To the task of prescribing a remedy, Mr. Tait at once addressed himself, and with what success is made apparent in the report for the financial year ending June 30th, 1904. The gross revenue for the first half of the year was lower than it had been in any of the five years preceding, but for the last half of the year it was the highest ever obtained. For the whole year it was £70,297 more than was earned in any previous year. Notwithstanding the fact that in reducing the number of unnecessary trains, a very large reduction was made in passenger and mixed train mileage, the revenue from passenger traffic exceeded the average revenue from that source during the preceding three years.

The net revenue was the largest ever obtained, and per mile of railway and per traffic train mile the highest for many years. It was £220,806 more than the net revenue for the years 1900-01—the year with the largest previous traffic—and it was equivalent to 3.64 per cent. on the railway debt of the State. While there were deficits during the three preceding years—deficits which promised to be recurrent—(£80,808 in the year 1900-01, £163,227 in 1901-02, and £304,094, in 1902-03), there was a surplus for the year ending the 30th of June last of £519. That surplus is a small one, no doubt, but when the conditions that had obtained for twenty years are taken into account, the commissioners, Mr. Tait, the chief, and his associates, W. Fitzpatrick and C. Hudson, are to be congratulated upon a notable financial achievement. Especially is this the case when it is mentioned that the credit balance was not obtained at the cost of the staff, the management having avoided the percentage reductions and short time working which was in vogue in 1902-03.

The task which the State of Victoria set the commissioners was to rehabilitate the finances of her railways. That has now, in a large measure, been done. The commissioners have contrived, as has been said, to collect, in their first year, the highest gross revenue ever recorded, and to make the highest net revenue for more than twenty years. Having succeeded so well in that department, the people of Victoria are now looking to the commissioners to provide what they consider more adequate railway facilities. How well Mr. Tait succeeds in this respect will only be known after another year has elapsed.

GREAT RELIEF VALVE.

What is probably the largest valve of its type that was ever constructed has recently been made by the G. M. Davis Regulator Company, Chicago, Ill., and is to be installed at the Donora works of the Carnegie Steel Company, Donora, Pa. It is for a 46-in. pipe and weighs complete 7,800 pounds. It will be placed at the end of an exhaust line in a vertical position about 18 ft. above the level of the floor. This exhaust line into which five large condensing blowing engines exhaust, is approximately 215 feet in length and is gradually increased in diameter at different intervals from 28-in. at the beginning to 46-in. at the end. The low pressure cylinders of the engines work under vacuum, and the object of the valve is to automatically provide a free relief to the atmosphere, if for any reason the vacuum is lost. If such provision were not made there would be danger of damaging the engines by the accumulation of back pressure. The valve body is of cast iron. The inner disc, which is guided at the top and bottom by spiders cast in the body, is of cast steel. It is faced with babbit metal and sits on a cast iron seat. A



2½-in. cold rolled steel shaft runs horizontally through the body of the valve on which there are two cut steel pinions, one of which is inside the body and meshes with a cast steel rack on the disc side. The other is at the end of the shaft just outside the body and meshes with a rack which leads to the hydraulic cylinder, and also with the segment to which is attached the lever carrying a cast iron counter-weight of 130 lbs. The valve is provided with this counter-weight to act as a safeguard by throwing the disc wide open as soon as pressure accumulates under it, and thus preventing any injury to the seat by pounding. On account of the unusual size of the valve and the weight of the disc, it was found not practical to make the valve wholly automatic. It opens automatically, but the closing is controlled by hydraulic pressure; an hydraulic cylinder 5 inches in diameter is connected at the top and bottom by a ½-in. pipe on which there is a four-way cock. This cylinder is under a constant pressure of 25 lbs. and when the valve is closed the cock is set to turn the pressure into the lower end of the cylinder. When it is desired to close the valve after it has been thrown open, this cock is set to turn the pressure into the upper end of the cylinder. A gradual closing is thus effected and the cock is again set at normal position.

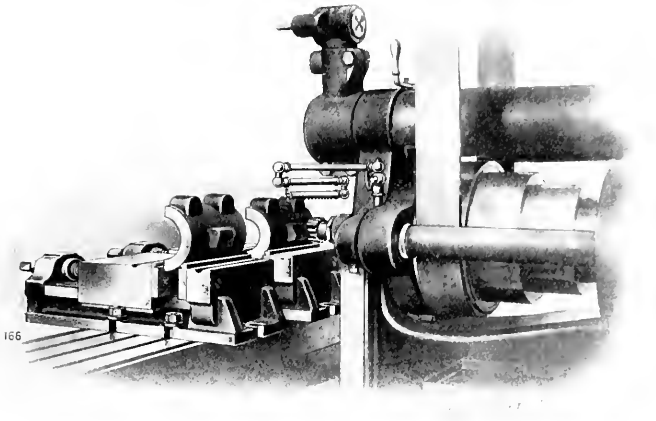
With the order for this valve was one for a 36-in. valve to be installed at the same works of the Carnegie Steel Company. The weight of this valve complete is 4,900 pounds.

MACHINE SHOP NOTES FROM THE STATES.

BY CHAS. S. GINGRICH, M.E.

X.

The art of making steel castings for machine parts has been so successfully developed, that these castings are now made by some steel founders to a degree of accuracy in regard to size equal to brass castings, and they are homogeneous in structure, easily machined, and are delivered to the customer entirely free from sand, and specifications usually require that all projections, such as stub ends of grates, sprues, etc., must



be machined off flush with the casting. This presents somewhat of a problem to the foundry men, as they do not, as a rule, maintain an efficient machine shop.

Of the tools that have been reasonably successful for this work, the draw cut shaper gave probably the best results until quite recently, when the Isaac G. Johnston Co., Spuyton Duyvil, N.Y., conceived the idea of using a miller. They made their first experiments on a No. 3 Plain Cincinnati Geared-Feed Miller, and proceeded in the manner shown in illustration herewith. The sprues average about 2½-in. long by 1¾-in. wide, and from ½ to ¾-in. high, and these are removed at a single cut in less than two minutes, using a Novo steel cutter 2½-in. in diameter and working at a surface speed of 80-ft. and feeding 2-in. per minute.

This is doing the work in about one-half the time in which it was done on the shaper.

NOVA SCOTIA'S GREATEST ASSET.

Nova Scotia has its farms, its fisheries, and its forests; but, although not so very long ago farming was held to be the backbone of the Province, to-day it is recognized and admitted, as the Hon. Robert Drummond points out in a recent issue of the Nova Scotian, that coal is king. Coal mining began to play an important part in the Province's development about the year 1825, when the General Mining Association expended some £300,000 in opening collieries. In 1858 the Legislature of Nova Scotia concluded an agreement with the General Mining Association, whereby the monopoly, so-called, was broken, and, though the agreement met with much opposition, they did that for the Province which, in the days to come, would put millions in its treasury. "For nearly 50 years, or from 1825 to 1875, it did not look as if the royalty from coal would ever assume the character of a bonanza, and become the Province's principal asset, but from 1875 forward the amount flowing from royalty, year by year, swelled, and last year formed the principal item in the returns of income. The percentage of increase of royalty from coal has been remarkable during the past five years. There are those who predict that in ten years the output of coal will have reached 10,000,000 tons. At any rate, if nothing happens to hinder development, the Province should, in ten years, be receiving $750,000 in the way of coal royalty. [illegible] is the Province [illegible] everything. It [illegible] Coal mining give [illegible] and it is calculated that at least [illegible] which is a considerable [illegible] Province with a population of 500,000 [illegible]

Coal is known to exist in [illegible] four of these it is being extensively worked [illegible] Richmond, no practical mining is at present [illegible] The coalfields of Nova Scotia having seams of [illegible] to 15 feet (or over) cover 902 square miles. The secondary coalfields with seams up to three feet thick cover 1,500 square miles. The probable coalfields under the newer rocks of the Gulf shore cover 1,500 square miles. As Mr. Drummond points out:

In the discovered coalfields of 4½ feet and upwards, the probable quantity of coal is from 7,320 to 8,000 million tons, according as the thickness of the seams is estimated.

The mileage and acreage for the several counties may be allotted as follows:

Name of County.	Square Miles.	Acres.
Cape Breton	450	288,000
Cumberland	300	192,000
Inverness	128	81,920
Richmond	84	53,760
Pictou	30	19,200
Total in acres		634,880

The thickness of the seams in the several counties average as follows:

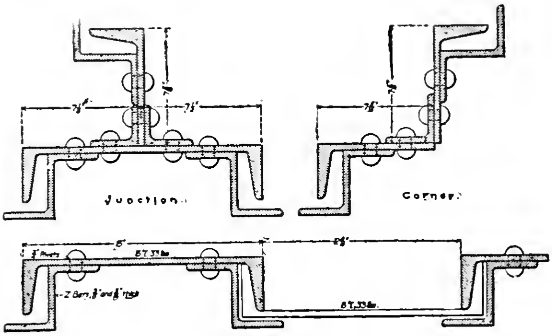
	Approximate Thickness
Cape Breton	10 feet
Cumberland	6 "
Inverness	15 "
Richmond	6 "
Pictou	11 "
	48 divided

by five, giving an average thickness of, say, 9½ feet

Compromising with the rule given by Merrivale in his "Notes and Formulæ," allowing 100 tons per inch for thickness per acre, and the rough way of calculating in Nova Scotia giving 10,000 tons per foot per acre, Mr. Drummond supposes there were 6,348,800,000 tons of coal in the field. Of this amount some 66,000,000 tons have been extracted, which still leaves about 6,250,000,000 tons in the fields of first importance. Outside this field, no one can estimate the quantity, but calculating the total amount to be won in all Nova Scotia as 10,000,000,000 tons, it can hardly be disputed that coal is Nova Scotia's greatest asset.

INTERLOCKING SHEET STEEL PILING.

We reproduce herewith photographs taken during the construction of foundation piers for Marshall Field & Co.'s warehouse on Polk St., Chicago. The foundation piers are of the caisson type and were planned to penetrate to a depth of 90 or 100 feet to bed rock. The soil is blue clay, soft sliding clay, quicksand, silt, and a stratum of about 15 feet of hardpan on top of bedrock. From the Manufacturers' Record we take the following description of the construction:



The first caisson was started with a wood curbing seven feet in diameter, with interior adjustable hoops made in two pieces and intended to hold the wood curbing in place. No trouble was experienced until a depth of 30 feet was reached, when all attempts to sink the well further were blocked by the clay and quicksand, which rose within as fast as it was

Steel Caissons Ready for Excavating.

removed. The surface of the street 30 feet away sank so much that Polk street bridge had to be closed for a time, owing to the sink-hole apparently caused by the removal of earth.

Steel Caissons Ready for Concrete.

A shield was then constructed of 1/2-inch steel plates in four sections to assemble in circular form. The shield had a sharp cutting edge and was forced down with hydraulic jacks, but this plan also failed, and the work was at a standstill.

Interlocking channel-bar piling was then provided and assembled in the form of a square, the piling being forty feet long, which was considered sufficient to pass through the soft strata. A No. 1 Vulcan steam hammer was used to drive the piling, which easily penetrated the upper strata that had effectually prevented the sinking of the caissons.

A cornerpiece was first placed in position between the leaders of the pile-driver, plumbed, and the hammer lowered to the steel cushion, which rested on the top of the piling to prevent battering by the hammer. The weight of the ham-

Method Employed in Driving.

mer alone—10,000 pounds—sufficed to force the piling down 25 or 30 feet, and eight or ten blows drove it into place. After the driving of a corner was accomplished, the ensuing piles were driven in turn until the square was completed. The perfect closing of the square was attained by the use of a special arrangement furnished with the piling.

The makers of this piling are the Friestedt Interlocking Channel Bar Co. The piling has been used in Chicago in connection with foundation work for the past two years, and is now in use extensively throughout the Western States for retaining walls, coffer dams, bridge piers, etc. It has many advantages over wood piling. It can be driven to a greater depth and with greater ease; being interlocking it closes up and prevents water coming through; and where it is used, as in the illustrations, it requires no cross-bracing, which in wood caissons forms a serious barrier to the removal of the soil. In the Marshall Field warehouse, the piling is about twenty feet longer than has been used before in similar work, and it is not yet known whether or not the sheets can be pulled out and used again. This, however, is a point of minor importance.

The item of cost has been considered by the manufacturers and owing to the method of rolling employed, the channel bar used is almost perfect in construction and at the same time comparatively low in cost.

PRODUCTION OF PETROLEUM.

The annual report of the United States Geological Survey upon the production of petroleum in 1903, presents a most comprehensive view of the industry. Following is an abstract of the Canadian section of the report:

Canada—Ontario—The production of petroleum in Canada comes almost entirely from the Petrolia and Oil Springs district in Lambton County, and Bothwell, in Kent County, Ontario. One of the first productive wells was put down at Oil Springs, in 1862, which flowed vigorously. For nearly twenty-five years the quantity of petroleum produced in Canada has been gradually declining, notwithstanding the opening of a number of smaller pools within the past four years. One of the most important of the recently developed pools is known as the Dutton district, in Elgin County. There was also some production in the southeastern portion of Essex County.

Nearly all of the crude petroleum produced in Canada comes from the coniferous limestone, and contains a considerable proportion of sulphureted hydrogen, which imparts an unpleasant odor to the finished product, unless removed by special treatment.

The wells are usually from 330 to 400 feet in depth, and are cheaply drilled, as only one string of casing is required. Owing to these conditions, there are a great number of wells in operation, compared with the production secured. The present production in Canada does not amount to more than 40 per cent. of the quantity consumed, the deficiency being supplied by the United States.

In Quebec a number of deep wells have been drilled in the last ten years on Gaspe Peninsula. In all, fifty-two wells have been drilled in this locality, from 500 to 3,700 feet in depth. A number of these have shown traces only of petroleum of good quality, one variety being much lighter in gravity than the other. There are several well defined anticlinials in a general southeast-northwest direction, more or less faulted. The strata containing the petroleum are sandstone, alternating with red or brown shales, which are supposed to be of Devonian age.

The recent developments south of Moncton, New Brunswick, are still progressing, and deeper drilling has developed more productive lands. The production in this field at the close of 1903 is estimated to be close to one hundred barrels per day, the product of fifteen wells, if pumped to their capacity. The depth varies from 1,000 to 1,500 feet.

Several deep wells drilled within the last four years near Lake Aimslie, Cape Breton, have failed to find petroleum in paying quantities, although the succession of shales and sandstone deposits are quite similar to those of the Pennsylvania productive region.

The development of petroleum, already mentioned in a former report, in southeast Kootenay district, Alberta, has not as yet taken place. There are some evidences of petroleum springs in this region, and the structural conditions are considered favorable.

Newfoundland—During 1903 another well was drilled near Parson's Pond, on the west coast, to a depth of 1,204 feet, which developed a flow of petroleum. Two other wells, drilled to a depth of 600 feet, developed considerable natural gas, but no petroleum. Up to this date, six wells have been drilled at this locality to sufficient depth, and five of them have found petroleum. The quantity is yet to be determined by pumping them a sufficient length of time to test their output. No new developments have recently been made at Long Point, where a number of small wells were drilled in former years.

The following is a statement of the production of crude petroleum in Canada for the years 1902 and 1903, by districts, in barrels of forty-two gallons:

District.	1902.	1903.
Petrolia	397,028	350,390
Oil Springs	60,747	56,405
Bothwell	50,141	48,880
Dutton	8,867	21,483
Raleigh	2,462	1,161
Wheatley	....	1,995
Leamington	....	1,190
Total	519,845	481,504

INDUSTRIAL NOTES.

A new post-office is to be erected in Winnipeg.

A cement brick factory willl be started at Galt by George Howes and George Booty.

The Norton Manufacturing Co., Hamilton, can manufacturers, are building a large addition to their factory.

John O'Leary, of Ottawa, has been awarded a contract to repair the leaks along the Galops Canal. The price is $10,000.

The Saginaw Salt and Lumber Company, of Sandwich, Ont., has closed down its plant until the latter part of next spring. Over a hundred men are thrown out of employment. The reason attributed for the shut-down is that the company has a quantity of cut lumber on hand sufficient to last until the middle of the coming summer.

The American Axe and Tool Co., which has three factories in the United States, is looking for a suitable site for a Canadian factory.

The new boiler works of the Goldie & McCulloch Co., in Galt, are practically completed, and are expected to be in operation before Christmas Day.

As a result of a trip through Canada by a party of French and Belgian bankers, headed by A. Demmer, of Paris, capital from France and Belgium will be invested in this country.

Plans for Toronto's new Union Station, on lines that will make the cost about three million dollars, will be drawn up by Architects Darling and Pearson, E. J. Lennox and Alfred Chapman.

The American Horseshoe Co. has acquired land in Hamilton, and will begin the erection of a factory in the spring. The plans call for a building 300 by 75 ft., constructed chiefly of steel.

An oil gusher, bigger than any yet discovered in Moore Township, was struck on October 31st by Messrs. Duncan, Dunfield and Wilkinson. This opens up a new oil field six miles from Petrolia.

The C.P.R., during the summer, laid down nearly four hundred miles of new track in the North-West, built several new bridges, straightened out curves, altered gradients, did some double-tracking, and commenced work in connection with the irrigation scheme in the North-West.

The Brotherhood of Maintenance of Way Employees, in convention in St. Louis last month, chose Toronto as the place of meeting for the next biennial convention. The new officers are: Grand president, John T. Wilson, St. Louis; first vice-president, A. B. Lowe, Kingston, Ont.; second vice-president, W. S. Powell, Greensboro, N.C.; grand secretary, C. Boyle, Merrickville, Ont.

The contract for the construction of the new Victoria Museum, at Ottawa, has been awarded to George Goodwin. The figures of his tender are understood to be slightly over $1,000,000, and it was nearly $300,000 lower than the next tender.

W. H. Wattman, late of Toronto, is starting a carriage factory in Perth, Ont. He will build the woodwork for broughams, landaus, hearses, etc.

Paul Bloch and Jules Weill, representing the Compagnie General des Products Metallurgiques de France, are now in this country investigating the iron deposits, and the prospects for a market for steel products. The company they represent have large factories in the south of France, and propose erecting steel plants in the United States and Canada. The Canadian plant would probably be located in Ottawa or Montreal.

Tenders are invited for a $200,000 lift lock, at Kirkfield, on the Trent Canal. The location will be between Lake Simcoe and Balsam Lake, or about one hundred miles from the Peterborough lift lock. The Kirkfield lock will be about ten feet shorter than the one at Peterborough, and the lift will be fifty-five feet, or ten less than at Peterborough. The towers at Peterborough are of concrete; at Kirkfield they will be of steel. The lock, as well as that portion of the canal on which it is located, will be completed next autumn.

It is reported that the Packard Automobile Mfg. Co., of Detroit, is negotiating to establish a branch factory in Canada. It has a factory at St. Catharines for the manufacture of incandescent globes, and will erect an addition to the establishment for the manufacture of motors. The St. Catharines council has agreed to submit a by-law to fix the assessment on the new industry at $12,000, and this will be voted on shortly. The company is required to pay $25,000 annually in wages and to have the plant in operation by February.

The Pictou smelting plant has been bought by the Inverness Copper Co., Limited, of Halifax, which has valuable mineral property at Cheticamp, C.B. The smelting plant was originally erected at a cost of $175,000, and two years ago it was improved at a further cost of $45,000. The present capacity is 100 tons per day. The new owners are putting it in condition for operation, and later will increase its capacity to about 300 tons. Besides smelting ores mined by the Inverness Co., the smelter will do custom smelting of copper, gold and lead. The original owners got into litigation and were forced to sell soon after completing the plant.

It is reported that the C.P.R. will build another elevator at Fort William, next spring, to have a capacity of 2,000,000 bushels.

Sandon & Sutherland, of Kingston, have been awarded the contract for erecting the Canadian mint in Ottawa. The price is $202,000.

The North American Saw Co., of Philadelphia, has purchased a site in Toronto, upon which it intends to erect a branch factory.

The gold medal for surveying and drawing instruments was awarded to W. F. Stanley & Co., of London, Eng., by the jury at the St. Louis World's Fair..

The Peterborough Radiator and Boiler Company will establish a factory in Peterborough for the manufacture of the Sturgeon heater, invented by a local plumber.

There is a proposal to establish an electric iron smelter at Peterboro. Power can be obtained cheaply, and ore from the Belmont mines is particularly adapted to electrical treatment, samples having shown 70 per cent. iron after magnetic separation.

The Dominion Iron and Steel Co. report so many orders in the wire department that double shifts of men will be put on. It is expected that the rail mill will be in operation in April. The company has purchased the machinery for its projected plate mill.

The Taylor-Forbes Co., of Guelph, are going into the manufacture of radiators, and hot water and steam-heating boilers. For this department a new plant is being constructed. J. P. Hockin, formerly superintendent of the Dominion Radiator Co., is associated with the mechanical department.

The large new shops of the Grand Trunk Railway, at Stratford, are rapidly nearing completion. Several carloads of machinery have been received from the John Bertram & Sons Company, Limited, Dundas, Ontario, which firm was awarded the contract for the entire equipment of iron-working tools.

The Montreal Water Committee will call for tenders for one 12-million gal. steam pump, one 12-million gal. electric pump, and one five-million gallon turbine pump. As but one 12-million gallon pump is needed, the committee will pick out the most advantageous tender, whether it is an electric or steam pump.

Ahearn & Soper, of Ottawa, have been awarded the contract for supplies for the Welland Canal, amounting to $60,000.

The sardine business of Eastport and Lubec, Me., is estimated at about $3,000,000 a year, and about two-thirds of the fish used come from Canadian waters. The Government Fish Commission is about to make a report, and, it is understood, that this will recommend drastic measures for the purpose of securing the sardine industry for the Maritime Provinces.

The contract for supplying 10-inch tubing for the pneumatic postal tube systems in Toronto and Montreal has been awarded to Messrs. MacLaren, of Glasgow. Forty thousand lineal feet, at a cost of $1.32 per foot, is being contracted for, and excavation for the work will begin next spring, as soon as the frost is out of the ground, and the system is expected to be in operation in both cities by the beginning of winter. John Galt, C.E., of Toronto, will be in charge of the construction work.

The Mond Nickel Company, of Victoria Mines, are roofing their new smelter with galvanized corrugated iron, supplied by H. S. Howland, Sons & Company, Limited, of Toronto. The iron is the "Orb" brand, made by John Lysaght, Limited, of Bristol, Eng. It is heavily coated and made specially for exposure to fumes, such as those at the smelting works. A. C. Leslie & Company, of Montreal, are general agents in Canada for this celebrated galvanized iron firm, who make iron for any special purpose, as well as for the ordinary requirements of the trade.

Four years ago James Clarke bought out the old Cape Breton Foundry and Machine Co., now called the Sydney Foundry and Machine Works, Sydney, N.S. After purchasing, he enlarged the works to twice their former size. This year Mr. Clarke bought over half an acre of adjoining property, on which he is going to build new boiler and construction shops, offices and stock rooms. The property is situated in the centre of the town, close to the railway and water front. The new works will comprise a modernly-equipped foundry complete with crane, tumbling barrels, brass furnaces, etc. Machine shop, and forge equipped with modern tools and appliances. Mr. Clarke's son, W. E. Clarke, is interested in the business in the capacity of superintendent. This year the firm added a 104-in. radial drill, and a 21-in. punch and shears, made by the London Machine Tool Co. of the latest design, and an hydraulic wheel press was added to the machine shop. The specialties of the establishment are C. I. water, and steam pipe and fittings, service and valve boxes, manholes and corporation castings, car wheels, bottle chocks and mining machinery, building columns and ships' propellers. Among new machines ordered are a set of power plate bending rolls and steam hammer. With these they will have one of the best-equipped shops in the Maritime Provinces. Mr. Clarke will be remembered by many of our readers as traveller for John Bertram & Sons Co., of Dundas, Ont., and as having been chosen by the Canadian Government to take charge of the machinery hall at the Colonial and Indian Exhibition, in London, in 1886.

MAP MOUNTING.

Maps or plans that are worth printing or drawing should be worth preserving, and cannot be so kept unless they are properly mounted. There are many ways of doing this, namely, mounted to hang on the wall neatly, either varnished or unvarnished, or on spring rollers to place in a cabinet, or for dissecting and folding to carry in the pocket or file away in a bookshelf. This work can only be done by experienced workmen, and our readers will no doubt be pleased to know that the Steinberger-Hendry Co., Toronto, whose card appears in our advertising columns, make map mounting their special business. They will give estimates on any work of this kind. They also carry in stock maps and atlases of every description and invite correspondence.

—A paper on Failures of Masonry Dams was read before the Engineering Society of the School of Practical Science, Toronto, on the 26th ult., by John S. Fielding, consulting engineer. About two hundred were present, and a hearty vote of thanks was tendered the lecturer. We hope to be able to publish this instructive paper in an early number.

—Prof. Gilbert, of the United States Geological Survey, predicts that the waters of the St. Lawrence upper lakes will in 3,000 years from now pass entirely by way of the Mississippi to the ocean, leaving Niagara Falls escarpment dry. In 500 years the process of tilting will cause an intermittent natural discharge at Chicago. For 1,500 years this discharge will be continuous. In 2,000 years the discharge at Chicago will be equal to the discharge over Niagara Falls. In 2,500 years the Niagara river will have become an intermittent stream. In 3,000 years all its water will be flowing to Chicago to pass down the Illinois river to the Mississippi. It will probably be worth while, however, for the companies at Niagara Falls to continue the installation of their power plants with the hope of at least 500 years' business.

—A contemporary having investigated the waste of coal, due to the dissipation of heat through improperly insulated steam pipes, comes to the conclusion that "from 5 to 25 per cent. of the coal can be saved by the proper insulation of pipes. Look out for the small pipes. If we run a battery of ten boilers with a 12-inch main, and perhaps a large engine, say 100 feet distant, we would lose, by condensation, in an ordinary uncovered pipe, from 400 to 500 pounds of coal daily. But if we divide the 12-inch main into twelve or fifteen 3-in. unprotected mains, and run them around indiscriminately within a radius of 75 or 100 feet, we can easily waste from 500 to 2,500 pounds of coal daily." In this connection it is interesting to note that the steam user is becoming appreciative of the saving of coal by good insulation, as is demonstrated by the growing demand for "Remanit," the remarkably efficient non-conductor of heat, made by The James Morrison Brass Mfg. Co., Limited, of Toronto, as a covering for pipes and steam mains.

STEAM TURBINE PROPULSION FOR MARINE PURPOSES.*

By Professor A. Rateau, of Paris.

There is no need, in a country which has given birth to the Parsons turbine, to insist upon the interest attached to the application of the steam turbine to the propulsion of ships. The remarkable results which the distinguished inventor of that engine has obtained are matters of common knowledge, and the author is one of those who have most admired and appreciated the methodical manner in which these results have been achieved.

There are, at the present time, two ships fitted with our turbines, namely, the French torpedo boat No. 243, and a first-class torpedo boat built by Yarrow & Co. The latter alone has been constructed according to our ideas, as the restrictions imposed by the naval authorities upon the French torpedo boat, and the conditions laid down for its propellers have created such difficulties that it has been impossible up to now to obtain a satisfactory speed with this vessel. It was, however, only a trial boat, and the speed was not required to exceed 20 knots; in point of fact, we have obtained over 21 knots. With Yarrow & Co.'s boat, on the other hand, the conditions are such as to utilize the full value of the turbines, and the latter have been further supplemented by a small reciprocating engine for economical working at reduced speeds. The trials with this boat are, therefore, of considerable practical interest, and I have much pleasure in acknowledging our debt to Mr. Yarrow for the breadth of view which he has shown in dealing with these new conditions.

Another small vessel, the "Libellule," was to have been fitted with a turbine of our manufacture, and the engine has been completed for some time past, but the trials have not yet taken place, as the special boiler with which it was desired to make the experiments was not ready.

Before going into the details of each of these applications of our system of turbines it may be well to set forth some of the obstacles which arise in using turbines for the propulsion of vessels, obstacles which, in the author's opinion, can only be satisfactorily overcome by a joint use of reciprocating engines and steam turbines.

As to the advantages of turbines, these are well known: absence of vibration, great reduction of weight, ease in handling, absence of wear and tear, etc. There is no need further to insist upon them.

The three principal difficulties in applying turbines to the propulsion of ships are as follows:

(1) Design and arrangement of propellers for a high speed of rotation.

(2) Efficiency of turbines at low speeds.

(3) Reversing and manœuvring powers.

(1). Arrangement of Propellers for a High Speed of Rotation.

When the turbines are not restricted to any particular speed of rotation, a very high efficiency can be obtained, certainly higher than that of the best reciprocating engines.

The author's experiments confirm this fact, which had already been shown by the published trials of the Parsons turbine. Unfortunately, the best speed for turbines is usually much too great for screw propellers. In high-speed vessels, by some give and take between engine and propeller, a working agreement can be arrived at; but it is not easy to do. The gearing of the rings has to be higher than with a turbine for other purposes, and the turbine itself must be divided up into several sections in series; and, further, it is necessary to devise some arrangement for the propellers by grouping them either singly, in pairs, or in threes on several shafts, and to so increase their surfaces that the extreme outside diameter shall be greater than the pitch, all of which tends to [illegible] of the engine and propellers.

If, therefore, the turbine is [illegible] to the reciprocating engine as regards [illegible] at full speed, it is not by any means [illegible] that the joint efficiency of both engine and propeller is better, or even as good.

The practical difficulties, moreover, increase as the speed diminishes, for in the first place the total surface (and consequently the size of the propellers) is mainly determined by the principal cross section of the ship, whereas, on the other hand, the size of the turbines is limited only by the speed of rotation, and not by the power developed. The speed of the turbine must be reduced in proportion to the speed of the ship, so that the dimensions of the former are increased, either by the number or the diameter of the moving rings, whilst the power diminishes approximately as the inverse of the cube of the speed. There is, therefore, a lower limit of speed, below which the use of turbines cannot be recommended. The author has already expressed the opinion (in a paper read before the Association Technique Maritime in 1902) that this limit is in the neighborhood of 20 knots. The author is aware that certain ships now under construction for transatlantic service, and of a proposed speed of seventeen knots, are being fitted with turbine engines, but the future will show how these will turn out.

(2). Efficiency at Low Speed.

If the steam turbine is capable of giving good results at the maximum power, it cannot be gainsaid that the results are certainly unsatisfactory at reduced speeds, not so much on account of the reduction of power as on account of the reduction in the speed of rotation, which involves a lowering of what is termed the "hydraulic efficiency" of the turbine. Curves showing the steam consumption per horse-power of a turbine, compared to that of a reciprocating engine, in terms of the speed of the ship assuming that this consumption is about the same in both cases at the maximum speed, indicate that at reduced speed the consumption of steam per horse-power for the turbine is much higher than for the reciprocating engine. This drawback is not important in the case of merchant vessels that keep at about their maximum speed. On the other hand, it becomes a serious one for warships that are rarely working at full power. The increase in the coal consumption at speeds of, say, 12 to 15 knots, at which they are usually working, would, however, greatly diminish their radius of action. A partial remedy, as used by Mr. Parsons, may be effected by adding a supplementary turbine for cruising purposes, into which the steam first enters when proceeding at low speeds. This, however, does not improve the hydraulic efficiency of the turbine, and the steam consumption nevertheless remains high.

The author considers that under no circumstances can turbines alone be economically worked at low speeds, and that the only satisfactory solution is the employment of a reciprocating engine of more or less power, according to the circumstances, in conjunction with turbines. With this combination economical results can be obtained at all speeds, and an example of this will be given later.

(3). Reversing and Manoeuvring Powers.

With a reciprocating engine stopping and reversing are effected in the simplest possible manner, whereas the very principle of the turbines is essentially opposed to this. Various inventors have tried to solve this problem by means of special blades to enable the same rings to be used for both directions of motion, but these attempts do not appear likely to come to anything, as one can only obtain reversibility by a considerable sacrifice of efficiency in forward motion. It is, therefore, necessary to supplement the turbine by special engines for going astern, and, as it is obviously impossible to have the latter as powerful as the former, one must be satisfied with a very much smaller speed astern than ahead. This difficulty in freely going astern makes manœuvring very awkward. The engine for going astern may be a reciprocating one, which would also be of

---

*From a paper read at the Institution of Naval Architects of Great Britain.

..se for going ahead, but it can just as well be a steam turbine. From the very start, Mr. Parsons used in his vessels special turbines for going astern, and these were attached to the same shafts as the main turbines, but this arrangement has the inconvenience of taking up a good deal of space lengthways.

In my patent of 1898 I have indicated how these can be fitted so as to be, as it were, hidden inside the main turbines on the low-pressure side, and without taking up any additional space. When they revolve freely, the astern rings offer no appreciable resistance while the main turbine is at work, and, conversely, the latter is idle when the astern turbine is in motion. This is the arrangement we have got in torpedo boat No. 243 and in the "Libellule," and it has the advantage of great simplicity. I think that Mr. Parsons has also made use of a similar arrangement in a certain number of his recent vessels.

According as the astern turbine is more or less developed, so the astern speed is more or less increased. With a single live ring, as on torpedo boat No. 243, and for the same expenditure of steam, the stern speed will be about 40 per cent. of the speed ahead, but with two rings it can be increased to 50 per cent. Adding more rings, however, adds very little to the speed, unless the number is so greatly increased as to make this engine almost as important as the principal one.

For quickly stopping a vessel turbines are apt to be inconvenient. After steam is cut off, the propellers continue to revolve by the action of the water, and they usually carry around with them the live rings, for the resistance to rotation is very slight. One can, however, increase this resistance by admitting steam in the opposite direction on the astern rings.

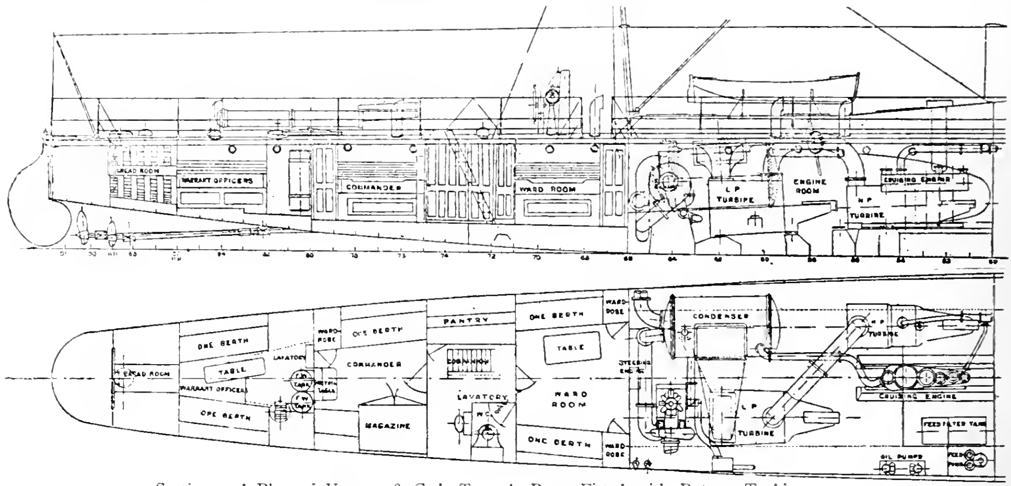
This question of stopping, reversing, and manœuvring is one which, in the author's opinion, may prove a serious hindrance to the extensive use of turbines for ship propulsion. It is particularly important for warships to be able to manœuvre with ease, and it will necessarily lead to the adoption of a combined system of turbines and reciprocating engines.

Combined Use of Turbines and Reciprocating Engines.

For the various reasons given above, the best solution appears, therefore, to be the simultaneous employment of reciprocating engine and turbines attached to independent shafts, in order that the reciprocating engine may be used at any speed. Each kind of engine is thus adapted to the work which suits it best. The reciprocating engine does for slow speeds, while the turbines come into play progressively as the higher speeds up to the maximum are required. They can, moreover, be equally well arranged for going astern, and the combination of the two then makes manœuvring almost as easy as with ordinary twin screws. An effective horse-power astern of 75 per cent., or more, of that when going ahead can thus be obtained.

The power of the reciprocating engine should not be less than one-sixth of the total, and it can quite well be increased to one-third or even to one-half of the maximum horse-power. It may be urged that this arrangement is complicated, and that if such an important reciprocating engine is to be retained, it is better to stick to the present system. In reply to this objection, however, the following advantages may be shown:

(1) Reduction of weight, although rather more space is taken up in plan.



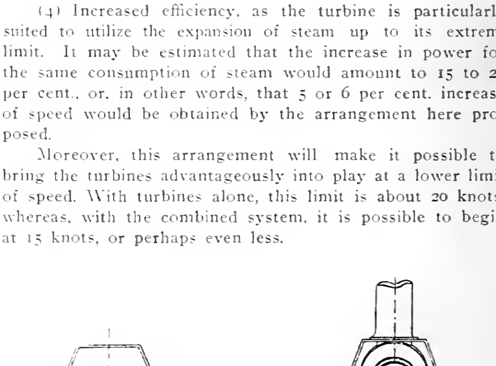
Section and Plan of Yarrow & Co.'s Torpedo Boat, Fitted with Rateau Turbines.

(2) Easier working and maintenance, and subsequent saving in personnel.

(3) Reduction of the vibration due to the reciprocating engines.

(4) Increased efficiency, as the turbine is particularly suited to utilize the expansion of steam up to its extreme limit. It may be estimated that the increase in power for the same consumption of steam would amount to 15 to 20 per cent., or, in other words, that 5 or 6 per cent. increase of speed would be obtained by the arrangement here proposed.

Moreover, this arrangement will make it possible to bring the turbines advantageously into play at a lower limit of speed. With turbines alone, this limit is about 20 knots, whereas, with the combined system, it is possible to begin at 15 knots, or perhaps even less.



The Rateau Turbine.

The author's design of turbine consists of a series of flat moving rings, varying in number according to the requirements, and fitted on a single shaft. These rings are placed between circular discs whose rims fit into grooves on the inside of the casing. The shaft traverses these diaphragms through bushes, which allow but little play. Elsewhere, the clearance between the moving and the fixed parts generally exceeds 3mm., and can even be as much as 5 or 6 mm. without causing trouble. With this arrangement, and

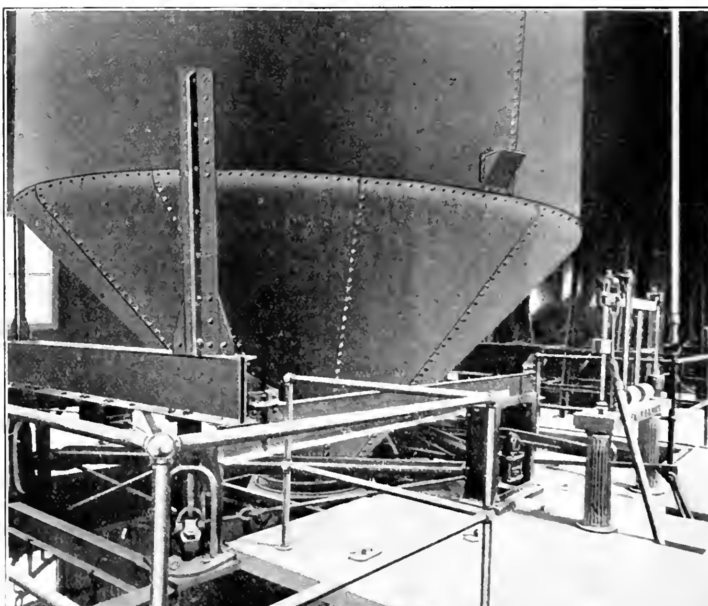
by using the work by "impulse" instead of work by "reaction," we have sought to obtain an engine using as little steam as possible, simple in construction, needing but little care in working, and capable of running for a long time with but little wear and tear, which, although inevitable, can yet be reduced to a very small amount. The loss of steam is entirely confined to the clearance allowed around the shaft. Moreover, the live rings are so constructed as to be very light, and this is of advantage in reducing the gyroscopic effect which comes into play when the vessel pitches.

It has been said that with this system, supposing one could reduce the loss of steam to a minimum, it would, on the other hand, greatly decrease the efficiency by the friction between the rings and the steam contained in the chambers in which the rings rotate. As a matter of fact, however, the friction in our engines of 1,000 to 2,000 horse-power amounts to only 2 or 3 per cent. of the maximum power—an insignificant proportion—whereas in turbines without diaphragms the loss by the escape of steam reaches 10, 15, and even 20 per cent. of the maximum horse-power directly the clearances increase at all. All the trial results so far obtained show that our system of turbines is extremely economical in steam consumption. The author concludes with examples of the work of some of his turbines.

FAIRBANKS HOPPER SCALE.

The accompanying illustration is one of four 1,800-bushel Hopper Scales installed in the Government elevator, "Commissionaires du Havres," No. 1, Montreal. This elevator has a capacity of one and one-half million bushels, and was erected by the Steel Storage and Elevator Construction Co. The entire elevator was built of steel and cement, and the scale frame-work of structural steel, as shown in illustration. These scales are of a type which have recently come into use in these new elevators and possess some advantages over the old type.

As shown in this illustration, the levers are hung from yokes which rest upon the steel frame-work of the floor on which the scales are set, thus bringing the working parts of the scale up above the floor-level and in plain view, so that any displacing of scale parts can be readily observed, and they can be kept free from dust and dirt. The scales are equipped with Fairbanks Patented Type Registering Beams, which print a ticket giving the weight of the load.


Fairbanks Hopper Scale.

The test of these scales was remarkably successful; out of a total capacity of one hundred and eight thousand pounds, the maximum variation that could be detected was 7 lbs., on one scale only 2 lbs. The scales are easily sensitive to 2 lbs. or one-fifty thousandth part of the load.

THE STANDARDIZATION OF ELECTRICAL MACHINERY.

London Engineering contains the interim report of the sub-committee of the Engineering Standards Committee on generators, motors and transformers, dealing with the principal conditions with which it is desirable that these articles should conform. The committee determined not to risk hampering the trade with standard dimensions and shapes which might easily become obsolete as designs improved, but confined themselves to the more immediate necessity of securing uniformity in pressures and frequencies, rating of plant and conditions of test. The standard voltages recommended are as follows:

Alternating or direct-current at the terminals of the consumer	110, 220, 440 and 500 volts.
Alternating current at the generating terminal	2200, 3300, 6600 and 11,000 volts.
Standard pressure at primary terminals of alternating-current transformers ...	2000, 3000, 6000 and 11,000 volts.
Standard pressure at secondary terminals of alternating-current transformers ...	115, 230, 460 and 535 volts at no load
Standard pressure at terminals of direct current traction motors	500 volts.

A variation of 10 per cent. either way is permitted in the above figures, so that plants built to the standards recommended may be employed on the great majority of the existing systems, although it is hoped that in course of time such latitude will become unnecessary. For alternating current a frequency of 50 periods per second is to be adopted as the standard, although in special cases, where a lower frequency is advisable, a secondary standard of 25 cycles is allowed. The difficulties in connection with the rating of generators and motors have been met by dividing the machines into two classes, according as they work continuously or intermittently. Machines of the former class must be capable of giving the rated output continuously for six hours, and the latter for one hour. When not otherwise specified, continuous working is always to be understood, and every machine is to bear name-plate giving such particulars of the output, voltage, frequency, revolutions per minute, exciting current and power factor, as bear upon its particular type. The output of generators is to be measured in kilowatts, and that of motors in brake horse-power. Direct-current generators are in future to be made in six standard sizes—from 6 to 100 kilowatts, inclusive—and a suitable speed has been recommended for each size. From 100 to 1,000 kilowatts, inclusive—there are nine sizes—machines up to 250 kilowatts having two alternative standard speeds, while above this size an

additional slow speed is added, making three speeds in all. Alternating-current generators are required to give a sine wave as nearly as possible under all conditions. The field excitation for simple alternators should be at either 65, 110 or 220 volts. The variation of pressure at the terminals between full load and open circuit under the same conditions of speed and excitation must not exceed 6 per cent. of the normal on a non-inductive load, or 20 per cent. on a load with a power factor of 0.8. Motors are classified as open, protected, ventilated or totally enclosed, a "protected" motor being one in which the interior is shielded from accidental contact without interfering with the ventilation; and a "ventilated" motor, one in which, although ventilated, access to the interior is only possible by opening or removing the casing. Direct-current motors are standardized in 15 sizes, from ¼ to 100 brake horse-power, inclusive; single-phase motors in 11 sizes, from 1 to 25 brake horse-power, and two and three-phase motors in 17 sizes, from 1 to 100 brake-horse-power. The speeds at full load are given for every size; and in the cases of alternating-current motors the figures are the synchronous speeds at no load, and a reduction of speed from 7½ per cent. in the smaller sizes to 2½ per cent. in the larger at full load must be allowed for. In connection with the work of the committee, experiments are being carried out at the National Physical Laboratory to determine the safe temperature rise allowable in the coils of dynamos and transformers. The results are not quite ready for publication, although the report indicates that they will be of considerable value, and will result in the recommendation of higher temperatures than have been advised by either the German or American standardization committees. Meanwhile, it is of interest to note that the temperature of the hottest part of a coil, as determined by measurements with a thermo-couple, never exceeds the mean temperature of the coil, by more than 25° C.

THE SIROCCO FAN.

Among the instructive exhibits at the World's Fair, St. Louis, is a set of fans made by the Sirocco Engineering Co., of New York. This consists of a steam driven 30-in. fan, an electrically driven 30-in. fan, and a 12½-in fan, electrically driven, for high pressure service. There is also a testing apparatus for comparing the efficiency of the various types of fans.

This fan, which is now to be placed on the Canadian market, is of British origin, the principle upon which it works having been discovered by a Mr. Davidson, of Belfast. In form the fan looks like a squirrel cage, and is composed of shallow blades set closely together with their outer edges inclined, strange to think, in the direction of rotation. The inlet for the air, and the outlet for its discharge, are approximately of a diameter equal to that of the fan itself.

These features are a reversal of previous theory and practice in regard to fan construction; but the practical effect of this new construction is, that in this centrifugal fan the volume of air discharged per revolution is several times greater than in other centrifugal fans of equal diameter. In describing this fan, the makers say: The inlet and discharge openings for the air passing through the "Sirocco" centrifugal fans being (relatively to the fan diameter), about four times larger in area than in centrifugal fans of other standard makes, the frictional resistance to the passage of a given volume of air per minute through the "Sirocco" is therefore only a sixteenth of what it is in other centrifugal fans; consequently "Sirocco" centrifugal fans show a higher efficiency in actual work done for the power applied, and much less weight and bulk, in relation to output. The velocity of air into the inlet opening of the fan is equal over the whole area of the intake, the air entering the fan inlet, so to speak, as a solid cylinder. The adjustment and arrangement of the other edges of the blades, relatively to the inner edges, are such that "Sirocco" fans possess the remarkable peculiarity, that the velocity of the air issuing from the discharge or delivery pipe of the fan exceeds the circumferential speed of the blades by about 80 per cent.; whereas in other centrifugal fans it seldom equals, and is generally less than, the circumferential speed of the blades. As a consequence, for a given duty, "Sirocco" fans can be run at much lower speeds than other makes; or, at a given speed, are capable of imparting a much higher velocity to the air than other fans of equal diameter. In "Sirocco" fans, the construction of the blades is such that the detrimental eddies which occur in other fans are obviated, as the circumferential speed of the inner edges of the blades is only slightly less than that of the outer edges, the difference between the diameters of the respective circles being unusually small. The organ-like "note" caused by such internal eddies, when the flow of air is at a very high velocity, is thus avoided, so that the "Sirocco" fan is practically silent in operation, even when running at high speeds. Another remarkable thing is that there is no end thrust on the fan shaft, even when the air is drawn into the fan on one side only. "Sirocco" fans are made in a number of different types to suit various requirements, and are applicable for driving by belt or rope any form of motor, or may be direct-coupled to such motors. A difficulty which is often experienced in regard to the employment of direct-coupled fans and motors, is the fact that the speeds for which standard types of motors are wound, relatively to their power, are usually more or less unsuitable for the duty required from the fan. For instance, one fan may absorb 2-h.p. at 500 revolutions, while another fan may only absorb this amount of power at, say, 1,500 revolutions. Now the standard speed of a 2-h.p. motor may be about 1,000 revolutions, and, obviously, therefore, stock sizes of motors cannot always be used for such varying requirements, and a necessity has existed for getting the motors specially wound to suit each individual case. To meet this difficulty, the makers have designed and patented an arrangement of back-gearing, which is applicable to any form of motor, and by means of which the full power of the motor can be transmitted at any required speed to the fan shaft, while at the same time the arrangement is so designed that, if it is desired for any reason to withdraw the armature of the motor for examination or repairs, it is not necessary to dismantle the gearing. This gearing, however, is itself detachable, so that the motor can be converted at will either from an ordinary into a back-geared motor, or vice versa.

The fans have been remarkably successful for induced draft on boilers, both for stationary and marine use. One of these has been installed in the new Canadian Government cruiser launched in September from the shipyards of the Polson Iron Works, Toronto. A reference will be made to th[illegible] in a description of the cruiser.

RULES FOR THE ENGINE ROOM.

1st. When you enter the engine room spit on the floor. We have water, lye, soap and brushes, and we will clear up as soon as you leave.

2nd. Rub your hands on the polished work, it will give some one work to use the surplus polish.

3rd. Put your hands on the engineer's bright work, you will know whether it is smooth, hot or cold. Tell others to do the same.

4th. Stop in the engine room as long as you please. The engineer has nothing to do but entertain visitors.

5th. Be sure to tell the engineer that his engine is pounding or not running right, as he will not know unless you do; he will stop and make repairs while you wait.

6th. Don't tell the engineer who you are, he is a mind reader, and already knows who you are. Go anywhere in the engine room and you will please him.

7th. Advise him what to do, as you know best. The engineer is only there every day and does not have a chance to see as much as you will in an hour.

8th. When the engineer is busy making repairs, tell him a good story and if possible get in the way.

9th. Be sure and tell him all you know, it will not take long.

10th. Call again and repeat as long a story as you can.

11th. Pull out a cigar and light it, don't ask him to have one for if you do he will accept it.